ASH FALL

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

No. 55 December 2002

Message From the Chair

Last spring we submitted a grant application to the Canadian Geological Foundation to update and purchase more medals for the Career Achievement Award. The proposal was successful, and we were awarded $ 1400 from the Jérôme H. Remick III Endowment Trust Fund. We now have a 10-year supply of these medals, as well as for all three Gélinas awards (gold, silver, bronze). We are most grateful to the Foundation for their continued support of our awards program.

We all need to promote our Division by encouraging new members to join. For your convenience, a membership form is included at the end of this Newsletter. Please circulate this form to your colleagues, graduate students, undergrads, etc. Student members are particularly encouraged to join, since they represent our future. Students can join for only $ 6 or for free if they are already GAC members.

As many of you know, the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) is the leading organization promoting volcanology and igneous petrology on a worldwide basis. For several years, IAVCEI has had personal membership similar to GAC. What many of you may not know is that Canada has only 6 IAVCEI members. I feel that Canada is under-represented in IAVCEI, so please consider joining. To facilitate this, there is also an IAVCEI membership form included at the end of this Newsletter.

Some important meetings and workshops are coming up in the next few years, and they should all be good:

> 8th Field Workshop on Volcanic Gases, Nicaragua and Costa Rica, 26 March - 1 April 2003, http://volcgas.unm.edu/nextworkshop.htm

GAC/MAC 2003, Vancouver, B.C., 25-28 May 2003,
http://www.Vancouver2003.com

IUGG 2003, Sapporo, Japan, 30 June –11 July 2003,
http://www.jamstec.go.jp/jamstec-e/iugg/index.html

Cities on Volcanoes 3, Hawaii, USA, 14-18 July 2003,
http://www.uhh.hawaii.edu/~cov3/

State-of-the-Arc, Cascades, USA, 16-21 August 2003, leeman@ruf.rice.edu

GAC/MAC 2004, St. Catharines, Ontario, 12-14 May 2004,
GACMAC04@brocku.ca

IAVCEI 2004 General Assembly, Pucón, Chile, 14-19 November 2004,
http://www.sernageomin.cl/iavcei

The GAC/MAC 2003 meeting in Vancouver promises to be very interesting. The Division is sponsoring or cosponsoring three sessions: (1) "From mantle to magma: lithospheric and volcanic processes in western North America"; (2) "Mantle plumes and large igneous provinces"; (3) "Dangerous ground: assessing the risk of natural and man-made hazards". There are also two fieldtrips of interest, one to the Whistler Corridor and the other to Mount Meager. Abstract deadline is ***17 January 2003***.

John Stix
Chair

Archean pillow lavas exposed at the Giant Section, Yellowknife. Photo by Bill Padgham.

Annual VIP Meeting, Saskatoon, May29, 2002

The annual VIP Division meeting was held at the University of Saskatchewan during the GAC-MAC Annual Meeting in Saskatoon. Eleven division members attended the meeting, which featured the awarding of three Leopold Gelinas medals for the best B.Sc., M.Sc., and Ph.D. theses of 2001-2002.

The meeting began with a Report from the Chair, John Stix. John presented a list of possible or proposed symposia, Special Sessions, and field trips for the next three upcoming GAC-MAC meetings in Vancouver, St. Catherines, and Halifax, respectively. *Please note that any VIP/GAC member can propose a symposium, special session or field trip by contacting the organizing committee for any future GAC meeting (see the GAC website for details*). If you have an idea for such a session or field trip, contact John Stix.

A series of volcanology-igneous petrology papers for Geoscience Canada has been in the planning for several years now. Authors have been contacted, and the deadline for submissions no later than May, 2003. A "Facies Models"-style volume should be published in late 2003-early 2004.

A CD compilation of high-quality field photos of classic volcanic and plutonic field localities was proposed. Cathy Hickson already has a website featuring volcanoes in Canada at www.volcanocanada.com, and the possibility of adding to this existing site is

being investigated. The suggestion was made that the GAC might be interested in publishing this CD compilation, although copyright issues might be a complication.

Publishing Ashfall is a major effort for the Secretary-Treasurer and an expense for the Division. The current Secretary-Treasurer proposes to prepare Ashfall in electronic format (Adobe Acrobat) and distribute the newsletter by e-mail. If any member requests a hard copy, a print version of this newsletter will be mailed to that member. In the future, Ashfall should be posted on the GAC website.

Cathy Hickson described upcoming CIDA Geoscience Aid Project at the GSC. At least seven countries will participate, probably beginning in 2003-2004. Funding from Canada is approximately 12 million dollars over a six-year period. A field trip or field camp may be organized for 2003.

It was a pleasure to award three excellent students of volcanology and igneous petrology the Leopold Gelinas medals for 2001-2002. Michelle deWolfe of St. Mary's University was the Bronze Medal winner, Trevor MacHattie of Memorial University was the recipient of the Silver Medal, and Stefanie Schmidberger of McGill University took the Gold Medal. The medal citations were:

Bronze Medal Citation by Wulf Mueller:

It is with pleasure that I announce my (our) choice for the best BSc.-thesis for 2002 in Volcanology & Igneous Petrology, and hence the winner of the Leopold Gélinas Bronze Medal. The competition was very stiff so that decisions had to be made. Three studies were retained, and all three candidates conducted excellent science. They should be proud of their theses, and all did their directors' justice.
It is not easy making a decision, especially this year where each of the candidates deserves a medal in their own right. One study focused on the physical volcanology of an inferred primary Archean subaqueous pyroclastic deposit, using detailed volcanic facies mapping and petrography. The second was a well-defined scaled experimental study of how topographic relief (overlying landforms) influences caldera formation and geometric structures, and the third was a detailed petrographic, geochemical, and microprobe study of observed immisciblity textures in tholeiitic basalts. I retained these three theses, but unfortunately there can be only one winner. The BSc-theses were reviewed by colleagues at the University of Otago and myself, and the final decision was difficult. Important evaluation criteria were: 1) the science and the project, 2) presentation of data and observations, 3) discussion and synthesis of data with the integration of possible models, 4) the scientific language, and 5) technical thesis aspects, such as formatting, scientific quality of figures and diagrams, and overall presentation of thesis.

The two thesis for which there is an honorable mention are:

1) ***Yan Lavallée***, Universtiy of McGill; BSc-thesis entitled 'Caldera subsidence in areas of variable topographic relief: results from analogue modeling: Director Dr. John Stix

2) ***Dominque Richard***, Université d'Ottawa; BSc-thesis entitled 'Volcaniclastic rocks of the Hurd property, Harker Township, Ontario, Abitibi Greenstone belt

The BSc-thesis considered the best for 2002 was written by Michelle DeWolfe of St. Mary's University (Nova Scotia), entitled 'Petrological evidence for pervasive silicate liquid immiscibility in the Jurassic North Mountain Basalt, Nova Scotia'.

Mrs. Michelle DeWolfe conducted an excellent study of the North Mountain basalts and demonstrated the existence distinct iron- and silica-rich phases and globules in the mesostasis of the North Mountain tholeiitic basalts. The study shows that liquid immiscibility was an important process in the late stage igneous differentiation of the North Mountain Basalts. The study was based on field observations and a rigorous sampling programme. Subsequently, thin-section studies and electron microprobe analyses were conducted. The strength of this thesis is in the systematic approach and collection of sound data. The data is well presented and described, and the results are synthesized in a rigorous scientific manner. Furthermore, the candidate has gone the extra mile to incorporate excellent diagram's and photographs to make the story very credible. On the whole, the thesis is very well presented and shows the candidate has all the attributes of a curious and ground-truthing researcher. I wish Mrs. Michelle DeWolfe all the best for the future.

Michelle deWolfe

Silver Medal Citation by Brian Cousens:

It is a pleasure to present the Silver Leopold Gelinas Award to Trevor George MacHattie for his M.Sc. thesis "Petrogenesis of the Wathaman Batholith and La Ronge Domain Plutons in the Reindeer Lake area, Trans-Hudson Orogen, Saskatchewan". He completed his thesis at the Memorial University of Newfoundland under the supervision of George Jenner and aided in the field by Dave Corrigan of the GSC. Trevor performed a geochemical and Nd isotopic study along a transect through the Wathaman Batholith, a

continental sub-arc batholith formed during the Paleoproterozoic Trans-Hudson orogen. The problems that Trevor addressed while interpreting field and geochemical data included the petrogenetic relationship between the Wathaman Batholith and other plutons to the south that had previously been either included or excluded in "Wathaman" plutonism. His work lead to the understanding that the batholith is lithologically heterogeneous, and includes field and chemical evidence for mingling of mafic and felsic magmas. The geochemistry of the plutonic rocks is consistent with mixing of three end-members: subduction-modified upper mantle, Archean crust, and enriched lithospheric mantle, the proportions of which vary along the north-south transect. Trevor combined available geochronologic data with the geochemistry data to outline the magmatic history of the batholith, identifying periods when juvenile magmas interacted with the latter two components. The thesis is an outstanding contribution to the geology of the Trans-Hudson orogen.

Two comments. First, I am impressed with the amount of work that has gone into this thesis (and all three theses that were submitted for this award) and the clarity of the writing. At first, I was VERY unhappy with the thickness of the thesis…. I had several to read and evaluate. However, I enjoyed reading the thesis from cover to cover. Second, I have a message from George Jenner: Congratulations, and write this up!

Trevor MacHattie and Brian Cousens

Gold Medal Citation by John Stix:

It gives me great pleasure to award the 2002 Léopold Gélinas Gold Medal for Best Ph.D. Thesis in Volcanology/Igneous Petrology to Dr. Stefanie Schmidberger of McGill University for her thesis entitled, *"Hf, Sr, Nd and Pb Isotope Systematics and Major and Trace Element Compositions of the Archean Subcratonic Lithosphere Beneath Somerset Island, Arctic Canada"*. Her thesis was supervised by Professor Don Francis.

Stefanie's thesis is a masterly synthesis of major, trace element, and isotopic data which reveal the nature of the mantle roots and lithosphere beneath the northern Canadian craton. By detailed analysis of a series of mantle xenoliths, she demonstrates that the underlying mantle is highly refractory and distinct from the mantle beneath oceans and beneath post-Archean continental terranes. She shows that the lithosphere beneath Somerset Island is both chemically and isotopically layered, with the deeper lithosphere being more radiogenic in terms of Sr isotopes than the shallow lithosphere. Using Lu-Hf data, she establishes an age of 2.8 Ga for the shallow Somerset lithosphere. Stefanie postulates that the lower lithosphere is younger, possibly being added to the Archean shallow mantle during the Phanerozoic by recycling and subduction.

In summary, this Ph.D. thesis represents a major advance in our understanding of Archean sub-continental lithosphere. As such, it is fully deserving of the 2002 Léopold Gélinas Gold Medal.

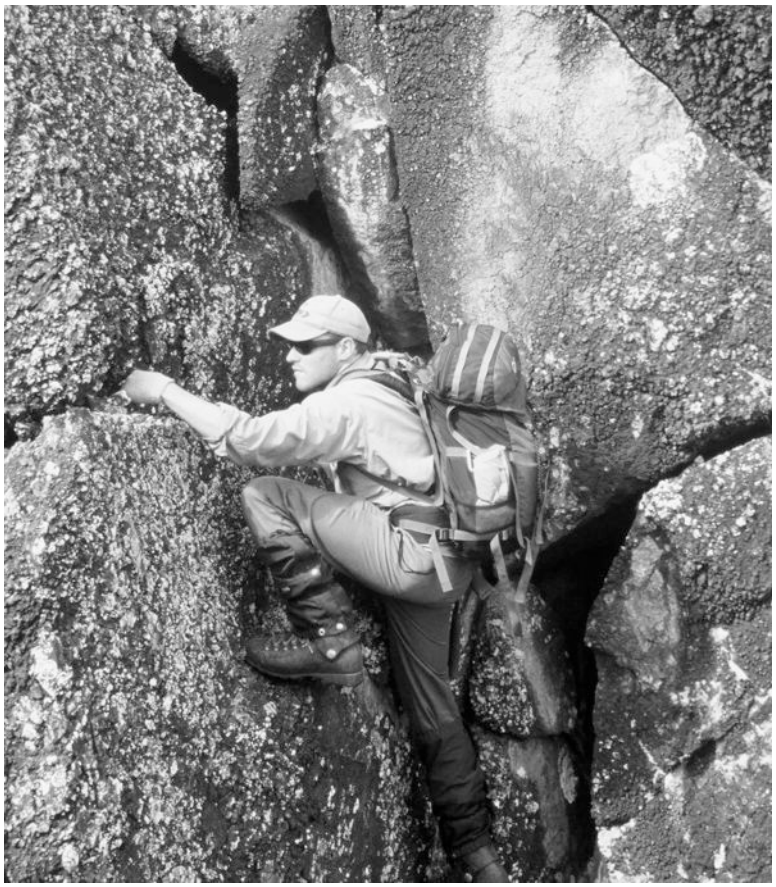
Stefanie Schmidberger

Post-pizza discussion of CIDA South America project.

Reports From VIP Members Across Canada

Earth Sciences, Simon Fraser University, Vancouver.

Studies of volcanology and igneous petrology at Simon Fraser University are being carried out by Dr. Derek Thorkelson and his graduate students to help understand the Proterozoic history of Yukon, and the early Cenozoic evolution of British Columbia. One of Derek's graduate students, John Laughton, is examining megaclasts of volcanic and plutonic rocks that occur in Middle Proterozoic hydrothermal breccias (see photo). The igneous rocks may represent rift events along the western margin of Laurentia following Wopmay orogenesis. His other student, Julianne Madsen, is studying Tertiary forearc granites and tonalites on Vancouver Island. The forearc setting of these rocks implies an unusual heating event, possibly caused by one or more episodes of spreading ridge subduction and slab window formation. Derek's former graduate students Wes Groome (now a PhD candidate at University of Maine) and Katrin Breitsprecher (currently at UBC) have recently had papers accepted by the GSA.



Above: John Laughton scaling cliff of Proterozoic breccia in search of igneous clasts.

Kelly Russell, Igneous Petrology Laboratory, University of British Columbia
and Ben Edwards, Dickinson College, Pennsylvania, USA:

Glacial pumping of magma-charged lithosphere: Northern Cordilleran volcanic province, British Columbia

The Stikine volcanic belt of the Northern Cordillera Volcanic Province (NCVP) is characterized by at least three long-lived stratovolcanoes that have produced alkaline magmas (Fig. 1). They are unique because they have produced intermediate to felsic, peralkaline, phonolitic magmas over protracted periods of time. The petrogenetic origins for these magmas involves crustal assimilation by more primitive alkaline basalt magmas.

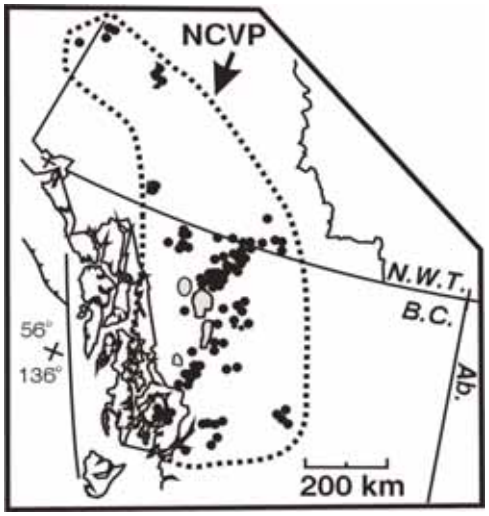


Figure 1 (left). *Inset shows location of northern Cordilleran volcanic province (NCVP; Edwards & Russell, 1998; 2000). Grey fields denote specific long-lived Neogene and Quaternary volcanic centres comprising the Stikine volcanic belt, including Hoodoo Mountain, Edziza, Level Mountain, and Hearts Peak (After Edwards et al. 2002).*

Figure 2 (right)*. Field photographs showing character of lower and upper cliffs cliffs produced by damming and ponding of lava flows by ice at Hoodoo Mountain (see Fig. 2B for location). (A & D) Prominent cliffs, 100-200 m in height, form the base of HMV and are interpreted as primary quench surfaces of lava flows that ponded against high-stands of ice.*

Much of this volcanism has coincided with periods of glaciation and the volcanic deposits show features indicative of ice-contact or subglacial eruption (Fig. 2). This suggests the possibility that magmatism is in part spawned by glacial loading of the lithosphere. Our current research explores the possible linkages between glacial loading and unloading events and the eruption of these felsic peralkaline magmas. Our analysis suggests that volcanism is facilitated by the AFC processes. We also show that glacial loading of the lithosphere can operate to suppress or enhance volcanism depending on whether or not the magma is supplied to the base or the surface of the ice sheet (Fig. 3).

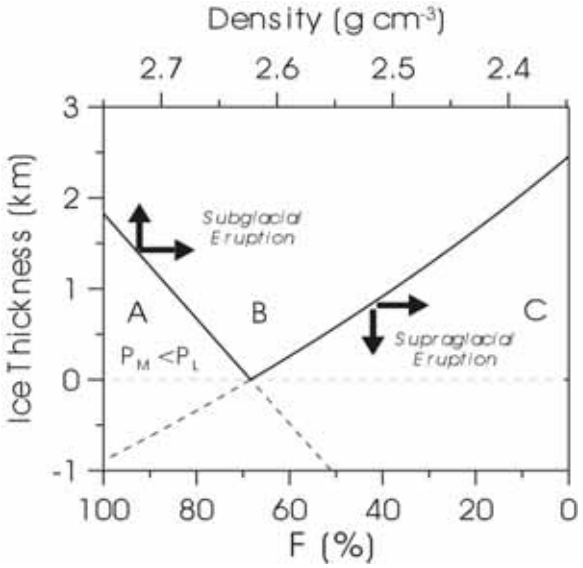


Figure 3. *Possible coupling between glacial events and AFC processes to support subglacial and supraglacial eruption of phonolite at Hoodoo Mountain volcano. Solution space has 3 distinct domains. A) No eruption where ice load is insufficient to compensate for relatively high density of magma. B) Subglacial to within ice eruptions are supported by ice loading or by decreasing magma density due to AFC processes. C) Supraglacial eruptions are driven by AFC processes creating buoyant magma or by decreases in ice thickness. The solid lines map the minimum conditions required for subglacial (left curve) or supraglacial (right curve) eruptions.*

Pertinent References:

Edwards, B.R., Russell, J.K., & Anderson, R.G. [2002]) Subglacial phonolitic volcanism at Hoodoo Mountain, northern Canadian Cordillera. *Bull Volc*, 64, 254-272.

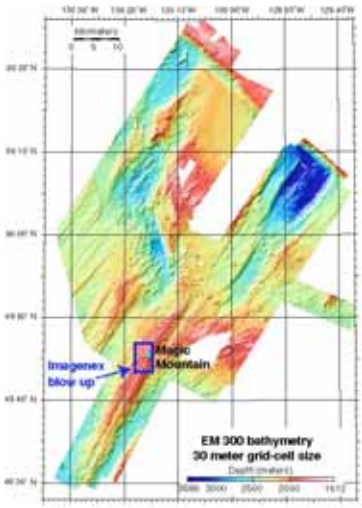
Edwards, B.R. & Russell, J.K. [2002]. Glacial influences on morphology and eruption products of Hoodoo Mountain volcano, Canada. *In: Volcano-Ice Interactions on Earth & Mars* (Eds. J.L. Smellie & M.G. Chapman) Geol. Soc. London, Spec. Publ., In Press 2002, 25 pg., 8 Figs.

Russell, J.K., Stasiuk, M.V., Schmok, J., Nicholls, J., Pager, T., Rust, A., Cross, G., Edwards, B.R., Hickson, C.J. & Maxwell, M. 1998: The ice cap of Hoodoo Mountain volcano, northwestern British Columbia: estimates of shape and thickness form surface radar surveys; *In*: *Current Research* 1998-A; Geological Survey of Canada, p. 55-63.

<u>*University of Victoria/McGill University/Carleton University/University of Toronto*</u>

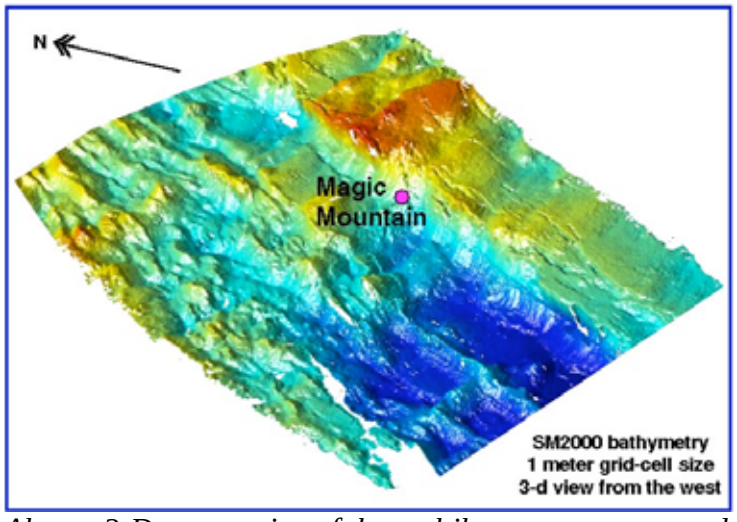
Ocean Exploration at Explorer Ridge, NE Pacific Ocean

Between June 28 and August 11th, 2002, a research cruise to Explorer Ridge and Axial Seamount, central Juan de Fuca Ridge, was conducted by NOAA's Ocean Exploration Program and partially supported by NSERC-funded Canadian researchers. Hard-rock Canadian participants included Kathy Gillis and Cathy Channing (UVic), Willy-Jones and Richard Leveille (McGill), Michele Burkholder and Brian Cousens (Carleton), and Yannick Beaudoin (UofT).



Left: RV Thomas G. Thompson, centre of operations for the 2002 cruise to Explorer Ridge. Right: New EM300 multibeam bathymetric map of the northern two-thirds of Explorer Ridge. Red is shallow, blue is deep water. The area surveyed in greater detail is shown in the blue box. Photo by Willy-Jones, map courtesy of NOAA.

The goals of the cruise, led by Robert Embley and Bill Chadwick of NOAA's Hydrothermal Vents team (Newport, OR.), were to investigate the biology, water chemistry, and geology of a relatively unknown hydrothermal vent field called Magic Mountain (blue box shown above). The northern two-thirds of Explorer Ridge were mapped using the *Thompson's* hull-mounted EM300 multibeam system. During Leg 1 of the cruise, towed-CTD surveys detected the vent plume from Magic Mountain in the water column, and the plume and seafloor in the vent area were mapped in great detail with Woods Hole Oceanographic Institution's Autonomous Benthic Vehicle, ABE.



Above: 3-D perspective of the multibeam map generated by ABE of the Magic Mountain area. Red is shallow, blue is deeper water. The pink dot mistakenly shows the Magic Mountain vent field as lying in the rift valley. It in fact lies to the northeast on the flank of the rift. Image courtesy of NOAA.

After onloading the Victoria-based remotely operated vehicle ROPOS, a trip to Axial Seamount and a crew change, the *Thompson* returned to the Magic Mountain area. At least 30 vents were found during nine ROPOS dives, ranging from extinct chimney fields to young chimneys venting water at 311°C. Unlike most vent systems in the Pacific, the Magic Mountain vent field is situated on the flank of the spreading centre, rather than in the primary rift valley. Basalt and sulphide/sulphate samples from the vent area were collected with the ROV, and an additional suite of basalt samples was collected using a wax rock corer deployed over the side of the *Thompson*. Analysis of the samples is ongoing, and some results will be presented at the upcoming Fall American Geophysical Union Meeting in San Francisco. For more information, go to the Ocean Exploration website at www.oceanexplorer.noaa.gov/explorations/02fire.

Above: Cross-section through a sulphide spire from the Magic Mountain area. Concentric zones of different sulphide minerals surround open orifices. Photo by Brian Cousens and Willy-Jones.

Volcanology at McGill – John Stix

The Volcanology Group at McGill is currently focusing on three principal themes: understanding the physical and chemical evolution of calderas; remote sensing of volcanic gases from the ground and from space; and unravelling the plumbing systems of active volcanoes. We have just obtained a $ 500,000 strategic grant from NSERC to pursue the gas remote sensing. Mike Branney and Tiffany Barry visited us in September

2002 to discuss calderas, pyroclastic flows, and mafic volcanism. We had two successful fieldtrips in the past two years, to the northern Cascades in October 2001 and to Long Valley caldera in California in November 2002.

The group continues to evolve and grow. Ph.D. student Ben Kennedy is spending a year in Munich and on Montserrat courtesy of the EU Volcanology Training Network. Crystal Mann and Oliver Schatz are finishing and writing up their M.Sc. projects, Crystal on Ilopango caldera in El Salvador and Oliver on boron partitioning between silicate melt and hydrothermal fluid. Marc-Antoine Longpré is collecting data on Piton de la Fournaise, Réunion Island, for his B.Sc. project. Guillaume Girard and Lois Wardell will arrive in January 2003. Guillaume is a Ph.D. student from Clermont-Ferrand who will be working on calderas and analogue modelling. Lois is a Post-Doctoral Fellow from New Mexico Tech who will be working on remote sensing of volcanic gases on the ground and from space. Yan Lavallée and Mathieu Richer obtained their B.Sc. degrees; Yan is now working with Shan de Silva at North Dakota, while Mathieu is surfing in Mexico and El Salvador.

McGill Volcanology Group at Crater Lake, Oregon, October 2001.

Other VIP News

Brian Cousens (Carleton University) and Hendrik Falck (CS Lord Northern Geoscience Centre) won the Mineral Deposits Division Julian Boldy Award for one of the three best papers in economic geology presented at the 2002 Saskatoon GAC-MAC meeting. An extended abstract of the paper is published in the fall issue of the MDD newsletter "The Gangue", which can be downloaded from the GAC website.

Acknowledgements: Thanks to John Stix, Derek Thorkelson, and Kelly Russell for their contributions to this newsletter.

It's coming up to that time of year again! On behalf of the VIP executive, I wish everyone a very Merry Christmas and best wishes for 2003!

Brian Cousens
Secretary-Treasurer