



ATLANTIC GEOSCIENCE SOCIETY LA SOCIÉTÉ GÉOSCIENTIFIQUE DE L'ATLANTIQUE

34th COLLOQUIUM & ANNUAL GENERAL MEETING

- Special Session:** [Mineral Deposits Research](#): the dynamics and processes associated with a specific mineral system applicable to furthering mineral exploration
- Special Session:** [Soil geochemistry](#): influences of genetic and environmental factors
- Special Session:** Presentations and Panel Discussion on Climate Change
- Special Session:** [Geochronology](#): "Timing, Timescales, and Tempo of Crustal Processes"
- Special Session:** [Sediment dynamics](#), oceanography and ecology of the greater Bay of Fundy: Scenarios resulting from tidal power development
- Special Session:** [Education](#) in the International Year of Planet Earth
- Special Session:** [Earth-based](#) studies of planetary surfaces
- General Session:** Current Research in the Atlantic Provinces (and Beyond)
- Workshop:** Geochronology Mini Course

February 1-2, 2008

Holiday Inn Harbourview, Dartmouth, Nova Scotia, Canada

PROGRAM AND ABSTRACTS



ATLANTIC GEOSCIENCE SOCIETY COLLOQUIUM

February 1-2, 2008, Dartmouth, Nova Scotia

Dear AGS members and guests,

Welcome to the 34th Atlantic Geoscience Society Colloquium and Annual General Meeting!

As you will see in the following pages, this year's Technical Program Committee has assembled a diverse program with six special sessions, a general session, a Climate Change Panel Discussion, and a geochronology mini course that will run at Dalhousie University on Sunday, February 3rd. We have received abstracts for 82 talks and 30 posters, and roughly one-third of these will be presented by student authors. In keeping with AGS tradition, we also have a busy social program planned, including a celebration of AGS' 35th Birthday and the International Year of Planet Earth, our Annual Awards Banquet, and the AGS Ceilidh and Jam Session.

The Local Organizing Committee gratefully acknowledges the generous support of all of the sponsors listed below, and wishes to thank the student volunteers, session chairs, and judges who will be helping throughout the weekend. We hope you have a chance to re-connect with old friends and make a few new ones, and that you have an enjoyable and rewarding conference.

Thank you for joining us!

Michael Parsons and Jennifer Bates
2008 Colloquium Co-Chairs

SPECIAL THANKS TO ALL OUR SPONSORS – 2008-AGS COLLOQUIUM

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NSERC Atlantic

ATLANTIC GEOSCIENCE SOCIETY

COLLOQUIUM & ANNUAL GENERAL MEETING

February 1-2, 2008, Holiday Inn Harbourview, Dartmouth, Nova Scotia

PROGRAM

Meetings, technical sessions, luncheon, & banquet are all at the Holiday Inn Harbourview, Dartmouth, Nova Scotia. For Colloquium registration information contact John Shimeld (John.Shimeld@NRCan.gc.ca) or Nelly Koziel (Nelly.Koziel@NRCan.gc.ca); or check the AGS website <http://ags.earthsciences.dal.ca/ags.php>.

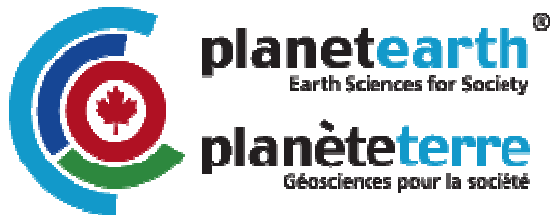
Friday, February 1st, 2008

- 10:00-19:00** Registration
- 10:00-14:00** Poster set-up
- 12:00-13:30** Upload PowerPoint files in speaker-ready room
- 14:00-24:00** Poster Session
- 14:00-17:00** [Soil Geochemistry](#): Influences of Genetic and Environmental Factors
- 14:00-17:00** General Session: Current Research in the Atlantic Provinces
- 14:20-17:00** [Mineral Deposits Research](#)
- 18:00-19:00** Student Poster Judging
- 19:00-20:40** Climate Change Presentations and Panel Discussion
- 19:00-20:40** General Session: Current Research in the Atlantic Provinces
- 20:40-24:00** Cash Bar
- 21:00-24:00** AGS 35th Birthday Party and Celebration of International Year of Planet Earth!

Saturday, February 2nd, 2008

- 08:00-17:30** Poster Session
- 08:20-12:00** [Sediment Dynamics](#), Oceanography and Ecology of the Greater Bay of Fundy: Scenarios Resulting from Tidal Power Development
- 08:20-12:00** [Geochronology Session](#): Timing, Timescales, and Tempo of Crustal Processes
- 08:20-12:00** General Session: Current Research in the Atlantic Provinces
- 12:00-14:00** Annual General Meeting and Luncheon
- 14:00-17:00** Earth-based Studies of Planetary Surfaces
- 14:00-17:00** Education in the International Year of Planet Earth
- 14:00-17:00** General Session: Current Research in the Atlantic Provinces
- 17:00-24:00** Cash Bar
- 19:00-22:00** Awards Banquet and Social
Speaker: Dr. Godfrey Nowlan, GSC (Calgary) - **“Earth to Canadians: Communicating Earth Science in the International Year of Planet Earth”**

A post-banquet tradition is the annual **AGS Ceilidh and Jam-Session**. The musically-inclined are invited to bring their instruments and entertain those of us who aren't so musically inclined. All instruments and styles welcome.



International Year of Planet Earth 2007-2009

AGS 2008: A Contribution to the International Year of Planet Earth 2008

Congratulations to the Atlantic Geoscience Society on your 35th birthday. The sessions at your Colloquium look very interesting and I hope you enjoy the celebration of your anniversary.

The main Canadian objective of International Year of Planet Earth is outreach. Our two goals are to increase public awareness of the importance of Earth Science in providing the energy and mineral resources essential to society and to reach out to young Canadians and excite them about careers in the Earth Sciences. The AGS support for teachers' workshops and other education initiatives and AGS public talks all provide strong support to IYPE. Your Nova Scotia Rocks brochure has been distributed to other Provincial Geological Surveys as a model for IYPE projects.

I can report some good news regarding IYPE in Canada. We have received some funding for the book "Four Billion Years and Counting". And we have strong indications that we will receive enough additional funding to assure the printing of an English and French edition, plus a website containing supporting materials. Of course, the inspiration for the book was your own - "The Last Billion Years"- and its success has greatly helped us in promotion of the new book.

Both the book and the associated website will be legacy projects, lasting far beyond 2008. It is very important that the IYPE projects in 2008/2009 help provide a legacy for the Canadian Federation of Earth Sciences to continue a program of outreach.

Our "Where on Earth, Where in Canada" web-based student contest has tentatively achieved support from a partnership between two large corporations, one energy and one mining. This is exciting and we look forward to the opportunity of helping to make this happen. We have some funding for the new Careers Website and are confident in complete funding for it. This also would be part of the legacy website, especially if we secure long-term funding for its continued support.

There are many smaller projects with local focus and they are, collectively, as important as the national projects. We will continue to seek funding for these.

Fund raising is important but managing the projects is vital. We will continue to need volunteers and we may well ask the AGS for help in finding volunteers to work on our projects.

John Boyd P. Geoph.
Chairman, Canadian National Committee

AGS 34th Annual Colloquium

LOCAL ORGANIZING COMMITTEE

Co-chairs: Michael Parsons (Michael.Parsons@NRCan.gc.ca) &
Jennifer Bates (JBates@NRCan.gc.ca)

Technical Program Chair:

Technical Program Committee: Sonya Dehler (SDehler@NRCan.gc.ca), Martin Gibling (mgibling@dal.ca), Michael Parsons, Georgia Pe-Piper (gpiper@smu.ca), Chris White (whitece@gov.ns.ca) & Graham Williams (Graham.Williams@NRCan.gc.ca)

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Registration: John Shimeld (John.Shimeld@NRCan.gc.ca) &
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Abstracts Volume: Chris White (whitece@gov.ns.ca)

Sponsorship: Mike MacDonald (mamacdon@gov.ns.ca)

A/V: John Gosse (john.gosse@dal.ca), Lawrence Plug (ljp@dal.ca) & Charlie Walls (Charles.Walls@dal.ca)

Awards: David Mosher (dmosher@NRCan.gc.ca)

Student Judging: Anne-Marie Ryan (amryan@dal.ca)

Social: Ian Spooner (ian.spooner@acadiau.ca)

Promotion: AGS Media Relations Committee
(Elisabeth Kusters (eckusters@hotmail.com), Deb Skilliter (skillidm@gov.ns.ca), Reg Wilson (Reg.Wilson@gnb.ca) & Grant Ferguson (gferguso@stfx.ca))

ATLANTIC GEOSCIENCE SOCIETY ANNUAL COLLOQUIUM

CONCURRENT TECHNICAL SESSIONS - FRIDAY AFTERNOON

* Graduate Student Presentation # Undergraduate Student Presentation
First author is the speaker unless indicated by a ►

AGS POSTER SESSION – Harbourside Terrace Friday 2:00PM – Midnight

GENERAL SESSION: Current Research in the Atlantic Provinces I – Hawthorne
Chairs: Brian Roulston and Erica Underwood

- 14:00 – #ERICA C. UNDERWOOD and GRANT A.G. FERGUSON - **Barium as a Possible Indicator of Biogenic Methane Generation**
- 14:20 – ARNFINN PRUGGER, JANELLE APPELYARD, TERRY DANYLUK, BALAZS NEMETH, and BRIAN ROULSTON - **Hydrogeological and geological inferences from core, well-logs, drill-stem tests and 3D seismic in the Sussex region of the Moncton sub-basin, New Brunswick, Canada**
- 14:40 – JANELLE APPELYARD, TERRY DANYLUK, BALAZS NEMETH, ARNFINN PRUGGER, BRIAN ROULSTON, and CHRISSY WILLISTON - **The future for Geology –3D interactive data: an example from the Sussex area of the Moncton sub-basin, New Brunswick, Canada**
- 15:00 – *NICOLA M. HARCOURT and DAVID G. KEIGHLEY - **Understanding the origin of deformed Albert Formation sandstone reservoirs: An analogue study with the northeastern Uinta Basin, Utah**
- 15:20 – **COFFEE**

GENERAL SESSION: Current Research in the Atlantic Provinces I (continued) – Hawthorne
Chairs: David Brown and Doug Stiff

- 15:40 – DAVID E. BROWN, SONYA A. DEHLER, KEITH LOUDEN, and YUE WU - **The Early Jurassic Heracles Sequence, Scotian Basin, Canada: Recognition of a latest stage synrift / pre-breakup tectonic and sedimentary event**
- 16:00 – *LESLIE S. ELIUK - **A tale of two microbialites – the Late Jurassic extremes: the #9 Limestone beneath the shelf margin delta of the Venture gas field in the Sable Island area versus the Albatross B-13 slope of the Abenaki shelf margin on the Western Shelf, Nova Scotia offshore Canada**
- 16:20 – #ERIC NEGULIC - **Hydrocarbon potential of the eastern Shelburne sub-basin and surrounding areas from petroleum systems modelling constrained by well log information, seismic images, and analogue models.**
- 16:40 – CHRISTOPHER D. JAUER and PAUL BUDKEWITSCH - **Old marine seismic and new satellite radar data: exploring for petroleum in the northern Frontiers**

SPECIAL SESSION: [Mineral Deposits Research](#) – McNab A
Chairs: Jamie Braid and Marcos Zentilli

- 14:20 – *DAVID A. SHINKLE, DAVID R. LENTZ, and STEVEN MCCUTCHEON - **The Lower Devonian North Pole Stream Pluton: A strongly peraluminous granitic complex hosting a polymetallic vein-type uranium deposit, New Brunswick, Canada**
- 14:40 – #CAROLYN GARRETT, JAROSLAV DOSTAL, ANDREW MACRAE, MALCOLM J. MCLEOD, and ASHLEY GARROWAY - **Late Paleozoic felsic volcanic rocks in southwestern New Brunswick: relevance to uranium mineralization in the region**
- 15:00 – *TONY BARRESI, JARDA DOSTAL, and JOANNE NELSON - **Metallogenic and Tectonic Significance of mafic volcanism in the Early to Middle Jurassic Hazelton Group, northwestern British Columbia**
- 15:20 – **COFFEE**

SPECIAL SESSION: [Mineral Deposits Research](#) (continued) – McNab A

- 15:40 – #ANGELA M. PAGE, DAVID R. LENTZ, and RYAN M. TOOLE - **Distribution, Form, and Origin of Precious Metals related to the Boomerang and Domino Volcanogenic Massive Sulfide deposits, Tunks Belt, Central Newfoundland**
- 16:00 – JACOB J. HANLEY, EDWARD SPOONER, and CRAIG HART - **Evidence from fluid and melt inclusions for synchronous sulfide melt oxidation and aqueous-carbonic fluid exsolution in intrusion-related gold deposits**
- 16:20 – ALAN J. ANDERSON, WILLIAM A. BASSETT, I-MING CHOU, ROBERT A. MAYANOVIC, and KENJI MIBE - **A Raman and X-ray absorption spectroscopic investigation of the structure and speciation of aqueous zinc bromide solutions at hydrothermal conditions**
- 16:40 – #JULIA J. KING and ALAN J. ANDERSON - **Microlite in the Greenbushes pegmatite, Western Australia**

SPECIAL SESSION: [Soil Geochemistry](#): Influences of Genetic and Environmental Factors – Sullivan
Chairs: Terry Goodwin, Mike Parsons, and Heather Jaggard

- 14:00 – ANDREW RENCZ and PETER FRISKE - **Trinational Soil Survey: Start of a North American geochemical data base**
- 14:20 – TERRY A. GOODWIN - **Summary of the Nova Scotia component of the North American Soil Geochemical Landscape Project**
- 14:40 – RITA MROZ, GERRY MCCORMICK, KOK-LENG TAY, KEN DOE, PAULA JACKMAN, TERRY GOODWIN, TOON PRONK, and MICHAEL PARKHILL - **Development of a background soil chemistry/toxicology database for the Atlantic Region and the North American Soil Geochemical Landscapes Project (NASGLP)**
- 15:00 – MICHAEL B. PARSONS, MEGAN E. LITTLE, and TERRY A. GOODWIN - **Background concentrations of arsenic and mercury in soils from the Montague and Goldenville gold districts, Nova Scotia**
- 15:20 – *COFFEE*

SPECIAL SESSION: [Soil Geochemistry](#): Influences of Genetic and Environmental Factors (continued) – Sullivan

- 15:40 – *LORI A. WRYE, HEATHER E. JAMIESON, MICHAEL B. PARSONS, and STEPHEN R. WALKER - **Distinguishing between geogenic and anthropogenic sources of arsenic in soils in the North Brookfield Gold District, Nova Scotia**
- 16:00 – ROBERT J. RYAN, DANIELLE FINLAYSON, and ANNE MARIE O'BEIRNE-RYAN - **Nova Scotia case studies of radon soil gas distribution and mobility**
- 16:20 – CLIFFORD R. STANLEY - **Partial digestions in soil geochemical exploration: How buffering, adsorption, and mineral stabilities influence data processing and interpretation**
- 16:40 – DISCUSSION

CONCURRENT TECHNICAL SESSIONS - FRIDAY EVENING

GENERAL SESSION: Current Research in the Atlantic Provinces II – McNab A
Chairs: Sandra Barr and Aaron Satkoski

- 19:00 – J. BRENDAN MURPHY, PHIL J.A. MCCAUSLAND, SEAN, J. O'BRIEN, SERGEI PISAREVSKY, and MICHAEL HAMILTON - **Geochemistry and Sm-Nd isotopic signature of the 0.76 Ga Burin Group: a compositional equivalent of the basement for late Neoproterozoic Avalonian magmatism?**
- 19:20 – *AARON M. SATKOSKI, SANDRA M. BARR, and SCOTT D. SAMSON - **Chemical and Sm-Nd isotopic constraints on the provenance and tectonic setting of late Neoproterozoic and Cambrian sedimentary and metasedimentary rocks in Avalonia of southern New Brunswick**

- 19:40 – REGINALD A. WILSON, CEES VAN STAAL, and SANDRA KAMO - **Lower Silurian subduction-related volcanic rocks in the Chaleurs Group, northern New Brunswick, Canada**
- 20:00 – *NIKOLAOS TSOUKALAS, GEORGIA PE-PIPER, and DAVID J.W. PIPER - **Unravelling the sources of the thick Miocene pyroclastic flows, Kos (Greece)**
- 20:20 – CLIFF S.J. SHAW, ALAN. B. WOODLAND, NESHA D. TRENHOLM, and J. HOPP - **Spatial and temporal evolution of the Rockeskyllerkopf volcanic centre, west Eifel volcanic field, Germany**

SPECIAL SESSION: Climate Change Presentations and Panel Discussion - Hawthorn
Chair: Martin Gibling

- 19:00 – GLEN LESINS - **Climate change: An atmospheric perspective**
- 19:20 – DAVID J. W. PIPER - **Anthropogenic climate change: a geological perspective**
- 19:40 – DONALD L. FORBES - **Climate-change impacts and adaptation: a coastal geoscience perspective**
- 20:00 – IAN SPOONER - **What is Climate Change? Engaging the public in a critical discussion**
- 20:20 – PANEL DISCUSSION
- 20:40 - Midnight ***POSTER SESSION AND CASH BAR – HARBOURSIDE TERRACE***

CONCURRENT TECHNICAL SESSIONS SATURDAY MORNING

GENERAL SESSION: Current Research in the Atlantic Provinces III – McNab A
Chairs: Colin Laroque and Kim Dalby

- 8:20 – *PETER NISHIMURA and COLIN P. LAROQUE - **Dendrochronological Analysis of Four Conifers in Western Labrador**
- 8:40 – COLIN LAROQUE and A. DEAN DUMERESQ - **Radial growth of trees from northeastern to southeastern Labrador**
- 9:00 – *MARIANA TRINDADE, TREVOR BELL, COLIN LAROQUE, JOHN JACOBS, and LUISE HERMANUTZ - **Dendroclimatic response of alpine treeline species in Central Labrador: a multi-species perspective**
- 9:20 – *BEN PHILLIPS and COLIN LAROQUE - **Expanding on Radial Growth Forecasting: Future Responses of Tree Species of the Acadian Forest to Climate Change**
- 9:40 – KIM N. DALBY, ALAN J. ANDERSON, ANTHONY N. MARIANO, and ROBERT A. GORDON - **Spectroscopic analysis of alkali feldspar from the Georgeville Granite, Nova Scotia: Evidence for pervasive metasomatic alteration**
- 10:00 – ***COFFEE***

GENERAL SESSION: Current Research in the Atlantic Provinces III (continued) – McNab A
Chairs: Cliff Shaw and Matthew Tucker

- 10:20 – #LISE ROBICHAUD - **Geology and architecture of deformation associated with the Scottie Creek fault, western Yukon**
- 10:40 – D. BARRIE CLARKE - **Silver-bearing alkali feldspars in experiment – and in nature?**
- 11:00 – #CHRIS YAKYMCHUK, MARY SANBORN-BARRIE, JOYIA CHAKUNGAL, and REBECCA JAMIESON - **Petrology and tectonic significance of coronitic mafic granulites, Southampton Island, Nunavut**
- 11:20 – #LUKE J. HILCHIE and REBECCA A. JAMIESON - **Graphite thermometry in the Halifax contact aureole**

- 11:40 – *SHERI A. LYON, SANDRA M. BARR, and SONYA A. DEHLER - **Sources of magnetic and gravity anomalies on the Scotian Shelf southeast of Cape Breton Island, Nova Scotia, and onshore-offshore geological correlations using geophysical modeling**

SPECIAL SESSION: [Geochronology Session](#): Timing, Timescales, and Tempo of Crustal Processes - Hawthorne
Chairs: Chris McFarlane, Paul Sylvester, and Sabine Schwarz

- 8:20 – DANIEL J. KONTAK, RICHARD HORNE, ROBERT CREASER, and DOUGLAS ARCHIBALD - **Correlation of thermo-tectonic and metallogenic events in the Avalon and Meguma terranes of Nova Scotia with the use of $^{40}\text{Ar}/^{39}\text{Ar}$ and Re-Os geochronometry**
- 8:40 – *SABINE SCHWARZ, DAVID R. LENTZ, DOUG ARCHIBALD, JIM WALKER, and STEVE MCCUTCHEON - **$^{40}\text{Ar}/^{39}\text{Ar}$ Age Dating of Three Shear-Zone Hosted Gold Occurrences, Northern New Brunswick**
- 9:00 – CHRISTOPHER BEAUMONT, REBECCA A. JAMIESON, and MAI H. NGUYEN - **Erosion-induced reactivation of the Main Central Thrust zone: Comparison of model results with tectonic and thermochronologic data**
- 9:20 – *JOSE LUIS ANTINAO, JOHN GOSSE, MARC CAFFEE, and ROBERT FINKEL - **Pleistocene landscape evolution of the southern Central Andes quantified with cosmogenic nuclide techniques**
- 9:40 – JOHN GOSSE, LES MCFADDEN, GUANG YANG, and ROBERT FINKEL - **What are Hoodoos and how do they form? Cosmogenic nuclide insights into Holocene landscape evolution in the Colorado Plateau**
- 10:00 – *COFFEE*

SPECIAL SESSION: [Geochronology Session](#): Timing, Timescales, and Tempo of Crustal Processes (continued) – Hawthorne

- 10:20 – *ALAN J. HIDY and JOHN C. GOSSE - **Variations in sedimentation rates to the western Gulf of Mexico over multiple glacial-interglacial cycles**
- 10:40 – STAVROS TRIANTAFYLIDIS, GEORGIA PE-PIPER, ROBERT M. MACKAY, and DAVID J.W. PIPER - **Monazite as a provenance indicator for the Lower Cretaceous reservoir sandstones, Scotian Basin**
- 11:00 – CHRIS MCFARLANE and MALCOLM MCCULLOCH - **In-situ LA-MC-ICPMS Sm-Nd dating using REE-enriched accessory minerals**
- 11:20 – TREVOR G. MACHATTIE, LARRY M. HEAMAN, and ROBERT A. CREASER - **Thermal structure and chemical composition of the Archean mantle and origin of mantle “plumes”: Insights from ca. 2.73 Ga komatiite and basalt, Nunavut, Canada**
- 11:40 – PAUL SYLVESTER, JIM CROWLEY, KATE SOUDERS, and JOHN MYERS - **500 million years of episodic anorthosite/leucogabbro – granodiorite/monzogranite (ALG) magmatism in the Archean Yilgarn craton**

SPECIAL SESSION: [Sediment Dynamics](#), Oceanography and Ecology of the Greater Bay of Fundy: Scenarios Resulting from Tidal Power Development - Sullivan

Chairs: Elisabeth Kusters and Kaitlin Almack

- 8:20 – ELISABETH C. KOSTERS, KARL BUTLER, GORDON FADER, TIM MILLIGAN, KEE MUSCHENHEIM, RUSSELL PARROTT, and DANIKA VAN PROOSDIJ - **A Research Agenda for Fundy: results from the 2006 ‘Fundy Session’ at Atlantic Geoscience Society**
- 8:40 – D. RUSSELL PARROTT, BRIAN J. TODD, JOHN E. HUGHES CLARKE, JONATHAN GRIFFIN, and TIMOTHY WEBSTER - **Preliminary results from multibeam bathymetry and LiDAR surveys in 2007 of the Bay of Fundy, Canada**
- 9:00 – TIM WEBSTER and PETER MACDERMOTT - **Evidence from LiDAR and Multibeam data of Post-Glacial relative sea level change in the Bay of Fundy region, Nova Scotia.**

9:20 – JOHN E. HUGHES CLARKE, SUSAN HAIGH, RUSSELL PARROTT, and GARRET DUFFY - **The relationship of actively migrating sand bodies to the tidal streams and eddies in the Bay of Fundy - new insights through combined mapping and modeling**

9:40 – JAMES WHITEHEAD, KARL E. BUTLER, and D. RUSSELL PARROTT - **The Quaternary erosional and depositional history of the Black Point area, Saint John, New Brunswick based on seismic sub-bottom profiles**

10:00 – *COFFEE*

SPECIAL SESSION: [Sediment Dynamics](#), Oceanography and Ecology of the Greater Bay of Fundy: Scenarios Resulting from Tidal Power Development (continued) - Sullivan

10:20 – GORDON B.J. FADER, D. J. WILDISH, D. RUSSELL PARROTT, and LAURA HUSSEY - **A conceptual model of horse mussel reef formation, Bay of Fundy, Canada**

10:40 – ELISABETH C. KOSTERS - **Winter ice and sediment budgets in upper Fundy**

11:00 – SIMON K. HASLETT - **The Severn Estuary (UK): Quaternary investigations and human exploitation**

11:20 – DANIKA VAN PROOSDIJ, TIM MILLIGAN, GARY BUGDEN, and KARL BUTLER - **A Tale of Two Estuaries: Comparison of Anthropogenic Impacts on the Contemporary Evolution of the Avon and Petitcodiac River Systems, Bay of Fundy**

11:40 – DISCUSSION

12:00 - 14:00 – ***LUNCHEON and AGS ANNUAL GENERAL MEETING – ALDERNEY***

CONCURRENT TECHNICAL SESSIONS SATURDAY AFTERNOON

GENERAL SESSION: Current Research in the Atlantic Provinces IV – Sullivan

Chairs: Ann Miller and Mike Lewis

14:00 – MURRAY GINGRAS, ► JOHN W.F. WALDRON, CHRIS. WHITE, and SANDRA M. BARR - **A unique Neoproterozoic to Cambrian trace fossil assemblage from the Goldenville Group, southwestern Nova Scotia.**

14:20 – DANIEL J. UTTING and JOHN C. GOSSE - **Ice-flow and deglacial chronology, Foxe Peninsula, southwest Baffin Island, Nunavut**

14:40 – ANN A.L. MILLER, C.F. MICHAEL LEWIS, DAVID J.W. PIPER, and GORDON B.J. FADER - **The Tail of the Bank Mud: A deposit originating from Agassiz –driven outburst floods?**

15:00 – *PAM J. DICKINSON AND BRUCE E. BROSTER - **The changing landscape of the lower Saint John River valley, New Brunswick**

15:20 – *COFFEE*

GENERAL SESSION: Current Research in the Atlantic Provinces IV (continued) – Sullivan

Chairs: Martin Gibling and Olivia Gibb

15:40 – MIKE LEWIS and STEVE BLASCO - **Newly-recognized lowstands of the Laurentian Great Lakes signal their sensitivity to changed climate**

16:00 – MARTIN R. GIBLING, RAJIV SINHA, NONIGOPAL ROY, SAMPAT K. TANDON, and MAYANK JAIN - **Paleolithic to Neolithic sites in the Belan Valley of India: early agriculture under an unstable monsoonal climate following the Last Glacial Maximum**

16:20 – PETA J. MUDIE, FABIENNE MARRET, RICHARD N. HISCOTT, and ALI E. AKSU - **Did Laurentide Ice Sheet Floodwater Change the History of European Civilization?**

16:40 – ALAN RUFFMAN - **Post-glacial tsunami hazard for eastern North America: real or imagined?**

SPECIAL SESSION: Education in the International Year of Planet Earth - McNab A

Chairs: Jennifer Bates and Heather Johnson

14:00 – GODFREY S. NOWLAN - **Earth science outreach in Canada: Cottage industry or national program?**

14:20 – JENNA BOON and JOHN CALDER - **Communicating the natural and cultural history of the Joggins Fossil Cliffs: A demonstration of innovation and collaboration.**

14:40 – ROBERT A. FENSOME, A. ACHAB, JOHN CLAGUE, DAVID CORRIGAN, JIM MONGER, GODFREY S. NOWLAN, and GRAHAM WILLIAMS - ***Four Billion Years and Counting: a book to celebrate Canada's geological heritage and International Year Of Planet Earth***

15:00 – GARTH J. DEMONT - **Marketing Geoscience Data**

15:20 – **COFFEE**

SPECIAL SESSION: SPECIAL SESSION: Education in the International Year of Planet Earth (continued) - McNab A

15:40 – RANDALL F. MILLER - **Geotourism in Saint John, New Brunswick**

16:00 – FENTON M. ISENER - **Getting geology into the grade IV classroom: The FENOREX collection**

16:20 – D. PATRICK POTTER and GRAHAM L. WILLIAMS - **Geological vignettes from York Redoubt, National Historic Site**

16:40 – HEATHER JOHNSON - **The carousel: a thinking activity for geoscience outreach enthusiasts**

SPECIAL SESSION: Earth-based Studies of Planetary Surfaces - Hawthorne

Chairs: Lawrence Plug and Marianne Mader

14:00 – RICHARD A.F. GRIEVE - **Impact cratering: A planetary process as seen from Earth**

14:40 – *SAMANTHA F. JONES and ALAN R. HILDEBRAND - **Acoustic velocity and elastic moduli profiles and corresponding fracture density and orientation patterns in artificially shocked granite: preliminary results**

15:00 – MICKAËL GERMAIN and ►MARIE-CLAUDE WILLIAMSON - **Geographic Information System for terrestrial analogue research and planetary databases**

15:20 – **COFFEE**

SPECIAL SESSION: Earth-based Studies of Planetary Surfaces (continued) - Hawthorne

Chairs: Marie-Claude Williamson and Samantha F. Jones

15:40 – RICHARD J. LÉVEILLÉ - **The search for life on Mars: the importance of Mars-like minerals on Earth to astrobiology**

16:00 – MARIANNE MADER and DENIS LACELLE - **Mineralogical investigations at Canadian Analogue Research Network (CARN) sites using a portable Raman spectrometer**

16:20 – CLAIRE SAMSON - **Synergy between terrestrial and space technologies: auto-synchronized 3D laser imaging and electromagnetic induction sounding**

19:00 – **AWARDS BANQUET AND SOCIAL – LAKE CITY BALLROOM A**

Speaker: Speaker: Dr. Godfrey Nowlan, GSC (Calgary) - **“Earth to Canadians: Communicating Earth Science in the International Year of Planet Earth”**

AGS POSTER SESSION – Harbourside Terrace - Friday: poster set-up 10:00-14:00; 14:00-24:00 Poster Session; 18:00-19:00 Student Poster Judging Saturday: 08:00-17:30 Poster Session

*** Graduate Student Presentation # Undergraduate Student Presentation**

1. JENNIFER L. BATES and MICHAEL B. PARSONS - **The challenge of collaborative environmental geoscience**
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30. #KARA-LYNN SCALLION, PEIR K. PUFAHL, and SANDRA M. BARR - **Phosphate Deposits in Cambrian Rocks of Avalonia in the Saint John area, New Brunswick**

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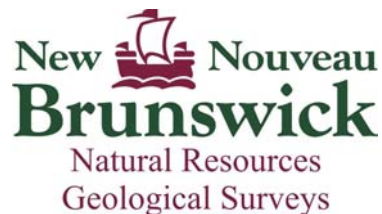


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A Raman and X-ray absorption spectroscopic investigation of the structure and speciation of aqueous zinc bromide solutions at hydrothermal conditions

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A Raman spectral study was carried out on three aqueous solutions of varying concentration and bromide/zinc ratio. Spectra were collected at 11 different temperature-pressure conditions ranging from ambient to 500 °C and up to 0.9 GPa. Raman band assignments for aqueous zinc bromide complex species reported in previous studies were used to determine the relative concentrations of ZnBr_4^{2-} , ZnBr_3^- , ZnBr_2 , and ZnBr^+ species at various temperatures and pressures. Our results are in close agreement with X-ray absorption spectroscopic (XAS) data, and confirm that the tetrabromo zinc complex, ZnBr_4^{2-} , is the predominant species up to 500 °C in solutions having high zinc concentrations (1 *m*) and high bromide/zinc molar ratios ($[\text{Br}]/[\text{Zn}] = 8$). This result is consistent with the observed predominance of the ZnCl_4^{2-} complex in chloride-rich fluid inclusion brines at high temperatures. In agreement with previous solubility and Raman spectroscopic experiments, our measurements also indicate that species with a lower number of halide ligands and charge are favored with increasing temperature in dilute solutions, and solutions with low bromine/zinc ratios ($[\text{Br}]/[\text{Zn}] < 2.5$). Raman and X-ray absorption spectroscopy are complementary techniques that were used in this study to obtain speciation and structural data on aqueous zinc bromide solutions at elevated temperatures and pressures. Furthermore, we show that Raman spectroscopy, in some cases, may be used to independently evaluate XAS data obtained from high temperature disordered systems such as supercritical fluids.

Pleistocene landscape evolution of the southern Central Andes quantified with cosmogenic nuclide techniques

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Landscape evolution studies depend critically on the quantification of long-term denudation rates. These are difficult to obtain in active mountain belts, because sediments are normally rapidly eroded in these environments. Terrestrial in situ cosmogenic nuclides (^{10}Be and ^{36}Cl) have been used in this study in different ways to estimate denudation rates in the southern Central Andes of Chile. An inventory of large bedrock involved landslides, with a chronology supported by ^{10}Be and ^{36}Cl exposure dating provides reconstructed sediment volumes to estimate denudation rates from landslides during the Pleistocene. Simultaneously, ^{36}Cl basin-wide average erosion rates were obtained for small catchments inside the same area. Both long-term (10^3 - 10^6 a) estimates were compared to short-term estimates based on suspended sediment records for the last 30 years.

Rates of denudation of ~0.1 mm/a were obtained using the landslide inventory data, similar to the ^{36}Cl basin-wide average erosion rates (0.15 - 0.23 mm/a). The estimations from suspended sediment records for the last 30 years show variable values, depending on their position along the orogen, between 0.03 to 0.15 mm/a. As accumulation inside the range is minor, there are two possibilities that can explain these observations, setting aside scale differences for the studied areas. Although for one area all estimates are similar within uncertainty, for others present day sediment transport by large rivers is out of equilibrium with long-term transport. The system might be currently transport-limited but during the Pleistocene it must have had periods of increased sediment discharge. A second alternative is that the bedload component of sediment transport needs to be incorporated more precisely into the estimations from suspended sediment records. Application of three bedload transport theoretical formulations to major rivers of the region supports this asseveration, suggesting that in this environment bedload can represent up to 80% of the sediment transport.

The future for Geology –3D interactive data: an example from the Sussex area of the Moncton sub-basin, New Brunswick, Canada

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The fault-bound Moncton sub-basin in southern New Brunswick is part of the larger Maritimes Basin which extends throughout much of eastern Canada. It is within this sub-basin that the potash deposit mined at Penobsquis occurs. In 2001 a new potash discovery was made in the Picadilly region just south of the Penobsquis mine. This discovery initiated a potash exploration program that involved drilling, 2D seismic, 3D seismic, airborne EM, and analysis of existing gravity data. These

data were analysed and integrated to create a spatially accurate regional model of all formations in the Sussex area of the Moncton sub-basin. This regional geological information is considered important for understanding the processes that created / altered the observed potash mineralization in this area. Initial surfaces of formation interfaces were created from seismic reflections and regional geological maps. Underground surfaces were calibrated using borehole data and deep layers lacking drillhole pierce-points were calibrated using surface gravity data. The process of creating these surfaces, constrained using all available data, will be described. The current best-fit model of each geological interface in the basin will be shown, formation-top by formation-top, and in cross-section, using real-time, interactive, 3D visualization software.

Field relations, structure, and provenance studies of Cambrian rocks in the Saint John area, southern New Brunswick

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Cambrian sedimentary rocks in the Saint John area of New Brunswick are assigned to the Saint John Group, and divided into (from oldest to youngest) the Ratcliffe Brook, Glen Falls, Hanford Brook, Forest Hills, Kings Square, Silver Falls, and Reversing Falls formations. The lowermost four formations are preserved only in fault-bounded slivers along the northern and, to a lesser extent, southern margins of the Cambrian belt in Saint John, and in folds associated with thrusting in the Mystery Lake area. Most of the exposed area of the Saint John Group is intensely folded Kings Square Formation. The overlying Silver Falls and Reversing Falls formations are preserved only locally in synclinal keels. The Ratcliffe Brook Formation is age-equivalent to the Chapel Island Formation in eastern Newfoundland and likely extends back into the Ediacaran Period of the Late Neoproterozoic. Redbeds in the Ratcliffe Brook Formation differ from similar rocks in the underlying Seeley Beach Formation of the Coldbrook Group (equivalent to the Rencontre Formation of eastern Newfoundland) in containing abundant detrital muscovite and less abundant pyroclastic material. New ⁴⁰Ar/³⁹Ar data from the detrital muscovite indicates a maximum age of ca. 620 Ma, and a minimum age of 550 Ma. The depositional age of the upper part of the Ratcliffe Brook Formation is constrained by a U-Pb (zircon) age of ca. 531 Ma from an ash horizon, previously published by Isachsen and others. As originally defined, the overlying Glen Falls Formation consisted of grey to white quartz arenite and overlying black phosphatic and glauconitic quartz arenite. Based on paleontological evidence, only the white quartz arenite is considered to be equivalent to the lithologically similar Random Formation of eastern Newfoundland, whereas the upper phosphatic and glauconitic part is included with the Hanford Brook Formation. Laser ablation MC-ICPMS analysis of 100 detrital zircons from the white quartz arenite in the Glen Falls Formation yielded a nearly unimodal age population with a peak at ~540 Ma, similar to the age of zircon grains in the dated ash unit in the underlying Ratcliffe Brook Formation. The age of the Hanford Brook Formation is constrained to Late Early Cambrian by fossils and also by a U-Pb (zircon) age of ca. 511 Ma from an ash horizon, previously published by Landing and others. The unconformably overlying Forest Hills Formation is mainly shale, equivalent to the Middle Cambrian Chamberlains Brook and Manuels River formations in eastern Newfoundland. The Kings Square Formation consists of interbedded, muscovite-rich, fine-grained sandstone, shale, and siltstone, and is equivalent to the Middle to Upper Cambrian MacLean Brook Group of Cape Breton Island. The overlying Upper Cambrian to lower Ordovician Silver Falls and Reversing Falls formations have been assigned to the Chesley Drive Group by some other workers. Nd isotopic data indicate that the provenance changed during deposition from more juvenile sources in the Seeley Beach, Ratcliffe Brook, and Glen Falls formations to more evolved sources in the Late Cambrian part of the sequence.

Metallogenic and Tectonic Significance of mafic volcanism in the Early to Middle Jurassic Hazelton Group, northwestern British Columbia

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The Hazelton Group comprises the youngest pre-accretionary rocks of the Stikine terrane in NW British Columbia. The group is dominated by several successions of Early to Middle Jurassic subaerial and submarine calc-alkaline island-arc volcanic and sedimentary rocks. One of them, the Salmon River Formation (SRF), which represents a brief period of volcanic activity at the boundary between the Aalenian and Bajocian, is compositionally distinct. The SRF is host to three economic VMS deposits, including the world class Eskay Creek Ag-Au and base metal deposit, as well as over 60 other VMS prospects. The Formation is preserved as several fault-bounded erosional remnants or separate sub-basins along a 200 km belt. The basins are filled with thick piles of pillow and pillow breccia basalt with minor amounts of rhyolite and sedimentary rock. Unlike other volcanic successions of the Hazelton Group, the SRF basalts are not accompanied by intermediate volcanics; they are island-arc tholeiites with a back arc basin affinity. There are two distinct varieties of the SRF basalt: type 1 basalts have a slight negative Nb anomaly accompanied by a slight depletion of the most incompatible elements, a flat REE pattern and absolute incompatible element abundances similar to MORB; type 2 basalts have moderate negative Nb and Ti anomalies, enrichment of the most incompatible elements, and a negative LREE slope. Epsilon Nd values for the basalts cluster between +3 and +4 (n=4) and between +6 and +7 (n=3). Type 1 basalts are the most juvenile isotopically, their +6 - +7 epsilon Nd values are unusual and represent a derivation from a more juvenile source than typical subduction-related basalt, whereas positive 3 - 4

epsilon Nd values of type 2 basalts are typical of Stikine Terrane island-arc volcanic rocks. Decompression melting of asthenospheric mantle is responsible for the type 1 basalts, whereas varying influences of subduction-modified lithospheric mantle account for the characteristics of type 2 basalts. The SRF basalts are critical to the formation of VMS deposits: i) heat from hypabyssal mafic magma bodies drove hydrothermal convection; ii) metals were scavenged from basalt in the volcanic pile; and iii) basalt caps the deposits aiding in preservation. The SRF has characteristics consistent with other VMS bearing bimodal-mafic dominated sequences (e.g. Kidd Creek and Noranda); it is associated with extensional, syn-volcanic structures and has geochemical features that are consistent with an extensional tectonic environment. Exploration for VMS deposits in the Hazelton Group should focus on a) targeting tracts of thick basalts; b) determining the structure of the depositional basin (i.e. syn-volcanic, graben or half-graben bounding faults); and c) geochemical analysis to determine the basalt characteristics. Only type 1 basalts are associated with known economic deposits in the SRF.

Evidence from LiDAR and Multibeam data of Post-Glacial relative sea level change in the Bay of Fundy region, Nova Scotia

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The post-glacial isostatic and eustatic history of the Bay of Fundy region is poorly resolved. Ongoing landscape evolution combined with the macrotidal shoreline environment complicates both the identification and resolution of indicators of past sea level. Research in ice sheet modeling, tidal power development, Mi'kmaq habitation patterns, and coastal erosion dynamics requires a better understanding of relative sea level change in the region. To date, few paleoshoreline features have been recognized and those that are known to exist exhibit little continuity making the resolution of isobases for the region problematic. In this study, LiDAR (Light Detection and Ranging) data have been combined with multibeam bathymetric data in order to identify both submerged and exposed paleoshoreline features along the North Mountain from Brier Island to Cape Split.

As paleoshoreline features (beaches, deltas, terraces etc.) have specific geomorphic form, methods that are being employed include using surface profiles to examine the lateral continuity between raised shoreline features, detailed slope analyses, lineament identification, and surface roughness coefficient discrimination. Preliminary results indicate that discrete shoreline features are best developed in association with paleo-drainage corridors. Linear features (beaches and terraces) are most commonly evident where glaciogenic deposits are extensive. At a number of sites multiple terraces indicative of episodic isostatic or eustatic adjustment are evident on LiDAR imagery. Multibeam imagery shows promise in resolving discrete low stand shoreline features and ice sheet dynamics.

The challenge of collaborative environmental geoscience

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The nature of environmental geoscience challenges the geoscience community to better its interaction with the public. Researchers need to be ready to discuss their scientific results and to address questions about non-geoscience topics such as implications for human health risk and property assessment values. Perhaps what is not as obvious, although equally important, is the need to accurately convey the same science to collaborators from other disciplines in multi-partner projects. Partners in these science teams initially need to define the problem to be addressed. Perhaps this is the first challenge of the group. Then, the varied aspects of the study must be divided up among the specialists in the team. Delineation of the responsibilities is critical and could require negotiation. All partners need to agree on the ways by which the results will be shared among project members, and how these can be integrated to better understand complex natural systems. Generating a common understanding of terms and processes that will act as a foundation for communication can be a learning experience for all. The science collective also needs to decide how it will address society's right to know and the anticipated questions from the public. Material prepared for specific audiences, appropriate venues, timeliness, and informed and media-savvy presenters are key factors. For many projects, conveying science to politicians of various levels, community leaders and regulatory agencies can be an important requirement. While the level of language is often similar to that of the public audience, these groups likely have a specific focus and objective and have an interest in the information that matches their mandate. This poster will introduce some of the challenges faced by the interdisciplinary, multi-partner project team investigating the environmental impacts of historical gold mines in Nova Scotia.

Erosion-induced reactivation of the Main Central Thrust zone: Comparison of model results with tectonic and thermochronologic data

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Recent thrust-sense deformation in the vicinity of the Main Central Thrust (MCT) zone in the Himalaya of central Nepal can be attributed to tectonics, erosion, or a combination of both. In the same area, contrasting cooling-age patterns in medium- and low-temperature thermochronometers have been interpreted to imply a recent (2.0-0.9 Ma) significant increase in erosional exhumation rates, likely attributable to recent climate changes. No comparable evidence exists for changes in local plate convergence rates. We use numerical models with constant convergence velocity but contrasting erosion rates to show that increased erosion and recent thrusting may be directly connected. In the models, increasing erosivity by a factor of 3 over 3 Ma fundamentally changes the style of deformation, reactivating the dormant model MCT system in the region corresponding to observed thrust faults. The high-erosion model also reproduces the observed cooling-age patterns, whereas the equivalent low-erosion model does not reproduce either observation. Other model predictions, and their implications for the effects of increased erosion on the southern flank of the Himalaya, include: 1) no associated reactivation of normal faulting on the South Tibetan Detachment (STD) system; 2) enhanced upper-crustal extension in the vicinity of the north Himalayan gneiss domes (NHGD); 3) re-invigorated mid-crustal channel flow beneath the NHGD; 4) possible destabilization and wholesale southward flow of the upper crust between the MCT and NHGD, with the potential for catastrophic earthquakes. The first three questions are testable and address the persistent question of the existence and current location of the low-viscosity channel. In particular, the model predicts that it has been stagnant beneath the Tibetan plateau under a relatively low-erosion regime, but has been, or could be, reactivated by more aggressive erosion driven by climate change. The potential for destabilization of the south flank of the orogen has important geological and societal implications.

MicroCT analysis of mineral phases, total and effective porosity in the Abenaki Formation, Scotian Shelf offshore eastern Canada

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Ongoing research on petroleum reservoirs offshore Nova Scotia includes analyses of carbonate material from the Abenaki Formation utilizing MicroComputed X-ray Tomography (microCT) a non-invasive procedure for imaging the internal structure of opaque objects. This method records spatial variations in the X-ray attenuation coefficient caused by mineralogical and porosity variations in a rock. The large differences between the attenuation of X-rays by solids, relative to that of air (i.e. pore space), ultimately permits the imaging and quantification of interparticle-, intraparticle- and fracture-porosity in a sample.

To date 22 core fragments from 6 wells, namely Panuke H-08, Panuke IA/1, Demascota G-32, Acadia K-62, Margaree F-70 and Albatross B-13, have been sampled in the form of small plugs approximately 11 mm in diameter. A variety of carbonate textures have been sampled in order to identify limitations and error ranges under differing analytical conditions using a Skyscan 1072 MicroCT scanner, with spatial resolution of approximately 10 μm . Textures include intercrystalline limestone with pinpoint vugs, stylolites, inclusions and fractures (H-08), intercrystalline limestone to dolomitic limestone with vugs (Panuke IA/1), intercrystalline limestone to dolomitic limestone having pinpoint vugs (G-32), intercrystalline dolomitic limestone with vugs in association with horizontal fracturing, oolites, pisolites and sporadic stylolites (K-62), intercrystalline limestone to dolomitic limestone with vugs, with sporadic fractures and stylolites (F-70) and pelloidal, oolitic lime grainstone, with intercrystalline pore cement (B-13). With reference to effective porosity, preliminary analysis of sample plug 12 from Panuke H-08 with bulk porosity of ~8% shows an average of 4.44% effective porosity. This means that approximately 50% of the total pore space (for this sample) that are sufficiently interconnected to provide conduits for fluid movement.

Carbonate samples tend to have a limited number of mineral phases present. This leads to the additional possibility of quantifying each phase by recognition of discrete grey-scale values. Preliminary microCT scans of a hydrothermal dolomite were undertaken at relatively low X-ray energy (< 100 keV). At such energies the photoelectric effect is primarily responsible for attenuation and the attenuation coefficient is a function of the effective atomic number (Z_{eff}), with attenuation increasing with Z_{eff} . Consequently, as well as total and effective porosity, carbonate mineral grains that are sufficiently large to be resolved by the instrument, and display contrasting Z_{eff} can be distinguished. In this case, the contrast in Z_{eff} between calcite (15.88) and dolomite (13.94) is sufficient to distinguish between the two minerals, though the presence of iron in ferroan dolomite decreases the Z_{eff} contrast.

Communicating the natural and cultural history of the Joggins Fossil Cliffs: A demonstration of innovation and collaboration.

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Paleontology is highly relevant to the modern and future world as this discipline can provide the public with an understanding of the depth of earth history and an ethic that includes, at its core, long-term stewardship for planetary wellness.

Specifically, the grand exposure of the Joggins Fossil Cliffs offers an opportunity for the public to understand the Carboniferous Period of the Earth's history where a significant evolutionary milestone is recorded. The Cumberland Regional Economic Development Association and three levels of government have collaborated to establish the Joggins Fossil Institute to present, promote and manage the Fossil Cliffs through a state of the art research and interpretive centre. The Joggins Fossil Institute has addressed challenges in communicating volumes of often complex scientific knowledge to varied audiences in a short period of time. In collaboration with various stakeholders and concurrent with an application for UNESCO world heritage site designation, interpretive planning and design was conducted to define the approach to telling the story of the natural and cultural history at Joggins. Interpretive planning promoted free choice learning through varied delivery mechanisms. As a result, audiences are not alienated as underlying evidence is presented in many ways and support individuals in developing their own conclusions. The Institute has developed educational materials that permit the teaching of science in a way that prepares lay people to not only understand geology but to also approach it critically. Ongoing research at the new Joggins Fossil Centre further supports visitors in appreciating the degree of uncertainty in Paleontology and engages those visitors in scientific methodology. Through integrating architectural and interpretive design processes, natural and cultural history is conveyed formally and informally. Scientists, educators, designers, and lay people provided validation of the messaging and approach in communicating the significance of the Joggins Fossil Cliffs in innovative, engaging and even fun ways.

The Early Jurassic Heracles Sequence, Scotian Basin, Canada: Recognition of a latest stage synrift / pre-breakup tectonic and sedimentary event

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Seismic profiles on the Scotian shelf, slope and abyssal plain offshore Eastern Canada reveal a previously unrecognized earliest Jurassic post-salt / pre-breakup stratigraphic succession. The Heracles Sequence is observed on the shelf margin as an eastward-directed infill succession within a series of half grabens having counter-regional, northwest-dipping boundary faults. On the slope, its inferred presence in the salt depocentre adjacent to the basin hingeline is masked by a thick wedge of later Mesozoic and Cenozoic sediments and salt structures. In deep water, it is recognized as a poorly-imaged but apparently extensive sequence between interpreted basement and the late Sinemurian breakup unconformity. At the eastern extremity of this region, it appears as westward-thickening wedges in highly rotated fault blocks.

The Heracles Sequence is interpreted as the product of the last phase of synrift tectonism prior to separation of the Nova Scotian and Moroccan conjugate margins in the late Sinemurian. Post-salt (early Hettangian) uplift of the mainland Nova Scotia shoulder region and the eventual rift spreading centre provided sources for sediments that prograded east- and westwards respectively into the main salt basin. Interpreted fluvial sequences advanced over marine evaporites ponding in depressions on a rifted basement setting and induced syndepositional halokenesis and the formation of salt-evacuation synclines. Where thin on the margins (especially near the future spreading axis), the salt provided a detachment surface and facilitated the observed high rotation on loading-induced fault blocks during a final uplift phase. This interpretation buttresses other geophysical evidence that suggests the underlying basement may not be oceanic crust, as previously proposed, but rather highly attenuated and fractured continental crust or serpentinized mantle.

The recognition of this late stage pre-breakup synrift sequence in the Scotian Basin offers important insights on this phase of the rifting process, and possibly its Moroccan conjugate and other margins. It thus has significant implications regarding the recognition of the continental crust and crustal boundaries, age and timing of syntectonic deposition and salt tectonism, original distribution and extent of marine evaporite sequences, timing and style of rifting, modelling of crustal heat flow, and petroleum systems attributes and modeling.

Silver-bearing alkali feldspars in experiment – and in nature?

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Most naturally occurring feldspars have compositions close to the fundamental K-Na-Ca plane, but other cations, such as Rb, Cs, Pb, Ba, Sr, and Ag, can extensively substitute for the alkali and alkali earth elements in the feldspar structure. Published low-temperature (ca. 300 °C) ion-exchange experiments have produced pure end-member silver feldspar ($\text{AgAlSi}_3\text{O}_8$) from a natural sanidine starting material. New high-temperature (600 ± 50 °C) synthetic granite melts can crystallize magmatic feldspars with a wide range of compositions ($\text{K}_{0.06-0.88}\text{Na}_{0.07-0.88}\text{Ag}_{0.0-0.46}$), showing the familiar miscibility gap between the potassium-rich and sodium-rich end-members, and much lower maximum of Ag in the K-rich feldspars ($\sim\text{Ag}_{0.20}$) compared with the Na-rich feldspars ($\sim\text{Ag}_{0.46}$). The ability of alkali feldspar to accommodate Ag cations in its structure potentially makes it an indicator mineral wherever it occurs as a coexisting gangue mineral (e.g., albite, cleavelandite, adularia) in epithermal silver mineral deposits. If so, coexisting feldspars from epithermal silver deposits, such as in the Freiberg District of the eastern Erzgebirge in Germany, the El Barqueno District in Mexico, the Comstock Lode in Nevada, and the Debert Lake prospect in the eastern Cobequid Highlands, now require re-investigation to assess their potential as indicator minerals, even though their silver concentrations may not exceed the parts-per-billion level.

The relationship of actively migrating sand bodies to the tidal streams and eddies in the Bay of Fundy - new insights through combined mapping and modeling

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The Bay of Fundy has seen ongoing multibeam mapping for 15 years now. Combined results currently provide a view of surficial sediments and morphology over about 60% of the Bay. As well as obvious relict glacial morphology, there are clear regions in which intense modern active sediment transport is resulting in the development and apparent concentration of mobile sand sheets. Most notably, headland-associated lens-like bodies of sand are found to be common, the most notable one being the Scots Bay sand wave field. It is apparent that for most significant coastal protrusions into the tidal stream, at least one, and often a pair, of these lens-like banks develop. In order to try to understand the association of these headland-associated sand bodies with the tidal stream, a series of nested, high resolution 3D barotropic finite-element hydrodynamic models have been developed, forced using the lower-resolution but spatially more extensive DFO Webtide models.

Many of the headlands develop eddies downstream of the flow. These eddies variously develop over the tidal cycle and advect away from the headland depending on the form factor of the headland. Although the instantaneous eddies clearly are not stationary, they result in a clear tidally-averaged residual inshore flow toward the headland. This is reflected in a ubiquitous development of asymmetric dunes in the inshore side of these lens-like bedform fields. In contrast the offshore side normally exhibit near symmetric bedform characteristics.

By coupling a sediment transport model to the variation in bottom bed shear stress observed over an M2 tidal cycle, residual sediment transport vectors have been calculated. The headland-associated banks are clearly related to, but offset from, local minima in the tidally averaged sediment transport vectors. The relatively simple geometry of the main coastal protrusions is reflected in the paired bedform fields. More complex residual sediment transport systems develop in and around the islands immediately to the south of Grand Manan including several lens-like sand bodies. The combination of a hydrodynamic and a sediment transport model help understand the more complex circulation in these areas.

Lithogeochemistry of hydrothermally altered host rocks about the Amaranth low sulphidation epithermal gold-bearing quartz vein, Waihi, New Zealand

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The Waihi epithermal vein system is located at the southern end of the Coromandel Peninsula, on the North Island, New Zealand. It is the largest of ~50 known deposits in the Hauraki Goldfield, which hosts a number of producing and past-producing, low sulphidation epithermal gold- and silver-bearing quartz veins. Veins presently being mined in the Waihi area are hosted by Miocene to Pliocene volcanic rocks of andesitic to dacitic composition of the Coromandel Group. Two main lithologic host units have been identified in previous studies and consist of a subadjacent quartz-plagioclase-porphyritic andesite and superjacent plagioclase-porphyritic andesite; the former generally hosts wider and higher-grade veins. Much of the Waihi area is overlain by younger ignimbrite, tuff, alluvium and volcanic ash from the currently active Taupo Volcanic Zone to the southwest.

The Amaranth Vein, one of several large veins in the Gladstone Hill area of the Waihi gold camp that have yet to be mined, is located just east of the town of Waihi, several hundred metres to the east of the high grade Martha open pit mine, and a few hundred metres to the west of the Favona underground mine. Rocks in the Gladstone Hill area are characterized by strong to intense hydrothermal alteration that is manifested by the presence of abundant clay minerals (muscovite, illite, interlayered illite-smectite, smectite, and chlorite) that have mostly replaced phenocrysts and groundmass. Typical alteration consists of an adularia-dominant assemblage of variable intensity overprinted by sericite and clay in the more extensively altered rocks. A commonly less pervasive propylitic chlorite-calcite-dominated alteration assemblage is also locally present. Pyrite and quartz are ubiquitous throughout the area and vein calcite, though prevalent in the nearby Martha deposit, is restricted to relatively isolated zones in the Gladstone Hill area. Alteration zonation is inconsistent with distance to the Amaranth vein. Alteration intensity estimates based on textural criteria may be correlated with the abundance of pyrite and hydrous minerals, but like the alteration zonation, exhibits little correlation with distance to the vein.

Spectroscopic analysis of alkali feldspar from the Georgeville Granite, Nova Scotia: Evidence for pervasive metasomatic alteration

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The late Proterozoic Georgeville Granite is an A-type granite situated about 20 km north of Antigonish, Nova Scotia. The bulk granite composition is characterized by high SiO₂, Th, Nb, Y and Zr and low CaO, TiO₂, MgO, FeO and MnO. Cathodoluminescence (CL) images, obtained from several thin sections of the granite, show that most feldspars display red luminescence. However, the inner regions of some plagioclase grains display a blue colour. These grains with blue inner regions and red rims are optically continuous and show no obvious signs of alteration when observed with a petrographic

microscope. Previous studies of feldspars in other igneous intrusions have attributed the red CL colour to the presence of ferric iron introduced by late stage fluids. In order to understand the metasomatic modification of the feldspars in the Georgeville Granite, the structure and chemistry of the red and blue CL regions was characterized using X-ray Excited Optical Luminescence (XEOL), X-Ray Absorption Spectroscopy (XAS), Synchrotron X-Ray Fluorescence (SRXF) and electron microprobe analyses. The XEOL results show that blue CL is strongly correlated with a UV feature at *ca.* 290 nm, and red CL is strongly correlated with an IR feature at *ca.* 720 nm. Both the 290 and 720 nm features are visible when the XEOL source was tuned below the excitation energy of the Fe K-edge. Using the XEOL spectra as a guide, XAS and SXRF spectra were recorded from red and blue CL regions. The XAS spectra indicate no change in either the coordination or the valence state of Fe between the red and blue CL regions. The SXRF data show that the red CL regions have higher concentrations of Fe³⁺ and Mn and lower Ca, Ti, and K than the blue CL regions. The blue CL regions within individual grains may therefore represent relicts of original plagioclase. Fe³⁺-enriched metasomatic albite is wide spread and readily identified by red CL.

Marketing Geoscience Data

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Homeowners with groundwater wells, road builders, land developers, tourism operators, regional economic development agencies, farmers and land-use planners form part of a long list of Nova Scotians who should be users of geoscience data, but unfortunately, they are not. This should be an issue of concern for all provincial decision makers, including MLAs and municipal councilors, because a failure to consider geology in the decision-making processes has implications for many aspects of society, including public health and safety, the natural environment, groundwater quality and economic development. The geoscience community needs to ask itself why its data are not being used? If you take the time to do the analysis required to answer the question you will likely reach the same conclusion made by the author. For the most part, we should all receive failing grades in marketing 100. The opportunity to change this grade has never been better than it is in 2008. The geoscience community is aware of the strong connection between geology and the environment. This year, while the environment tops the political agenda at every level of government, we all need to dedicate some time to drawing those connections for decision makers.

The changing landscape of the lower Saint John River valley, New Brunswick

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A 67m continuous core was recovered through drilling at Grand Lake Meadows, located at the junction of Grand Lake and the Saint John River, approximately 55km south of Fredericton, New Brunswick. Sediment samples were collected from the core to identify stages of development of the marsh land area and surrounding environs since de-glaciation and to assess the possibility of glacial occupation of the Lower Saint John River valley during the Younger Dryas.

Analytical tests included grain size (% gravel, sand, silt, and clay), loss-on ignition, and chloride and bromide content. Data collected were plotted with depth to identify sedimentary units overlying till as identified from earlier drilling in the area. Changes in concentration of variables with depth demonstrated an evolution of the Lower Saint John basin through five interrelated environments of deposition. Data were averaged over 0.5m sections of core to facilitate Spearman Correlation between variables, Q-mode Cluster analysis and Multivariate Discriminant analysis used as unbiased statistical methods to confirm the major depositional environments interpreted from core data.

Finite radio carbon dating (actual dates not discussed here) indicates that the area has likely remained as an open body of water since deglacial time (<12 000 BP). High chloride and bromide content throughout most of the core suggests that the water was brackish, varying in salinity since deglaciation when marine water was able to mix with fresh water over the study area.

As a result of this study, the Grand Lake Meadows, located approximately 70km upstream from the Bay of Fundy, is interpreted as having evolved through five stages of development from glacial deposition of till, followed by a marine incursion, with water over the area changing to brackish/lacustrine, then fluvial, and finally development of the present floodplain environment. The increase in the chloride and bromide content in more recently deposited sediments indicates a return to higher saline content in surface and groundwater in the study area that will likely be exacerbated by climate warming and continued rise of relative sea level. This has serious implications for the future supply of potable water in the surrounding areas and for the flora and fauna of the Grand Lake Meadows marsh lands.

Element mobility as a result of chemical weathering of a Carboniferous saprolite near Valparaiso, Chile

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A saprolite is preserved when the erosion rate is less than the weathering rate and thus not all weathered material is removed. The partially weathered material is therefore preserved in situ and displays varying weathering intensities through a vertical profile with an increased degree of weathering closer to the surface. As the saprolite develops, the more mobile elements can be released into the environment. Some of these mobile elements, in turn, form into new minerals; others are

released into water and soil systems in the vicinity. There are many factors affecting the rate of chemical weathering and thus the flux and dispersion of mobile elements through a saprolite. Factors include lithology, pH, presence and nature of overlying soils, precipitation, humidity, possible sea water incursion, temperature and microbial action.

A Carboniferous (290 Ma) granitic saprolite profile in the Chilean Coastal Range outcrops along a recently constructed highway near Valparaíso, Chile. Overlying sediments have protected the profile from erosion since the Miocene. The area is part of a larger study examining the history of the Andes from formation through the tectonic regime to uplift and weathering of the constituent rocks. The profile was sampled at varying depths through the vertical exposure, including fresh granite at the base of the section. Preliminary results suggest that there is indeed a change in the more mobile of the major, trace, and even REEs with depth in the weathering profile. CaO, Na₂O, Ba, Sr, Nd, and the light rare earths appear to increase with depth, whereas loss on ignition (LOI) and TiO₂ decrease with depth. Analyses also show a general slight increase of boron and chlorine in the upper more weathered layers which might reflect a marine influence. This study analyses the progress of weathering with depth, as part of an attempt at deriving a mass balance of the granite and its weathered products.

Sapping Channels in a Glaciofluvial Complex: A Possible Martian Analog?

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A number of short and wide channels occur in the Sandilands Interlobate Moraine in southeastern Manitoba. Estimates of flow rates based on the Manning equation suggest extremely low flow rates well beyond could be expected as runoff given their surficial catchment areas and suggest that groundwater sapping was important in their formation. These features are truncated by the Campbell Strandline, which has an age of approximately 9900 to 9400 ¹⁴C B.P. Hydrogeologic modeling suggests that during the drop the level of Lake Agassiz to the Upper Campbell level, the subsurface hydraulic gradients generated would have been sufficient to allow for groundwater sapping. A number of bowl-shaped depressions located above Upper Campbell Beach strandline likely have a similar origin as piping features. These sapping and piping features are of interest as a possible Martian analog due to their resemblance of similar geomorphological features that occur on the surface of Mars.

A tale of two microbialites – the Late Jurassic extremes: the #9 Limestone beneath the shelf margin delta of the Venture gas field in the Sable Island area versus the Albatross B-13 slope of the Abenaki shelf margin on the Western Shelf, Nova Scotia offshore Canada

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Carbonates are not like siliciclastics. In fact carbonates, especially modern coral reefs, do not like siliciclastics and their often-associated nutrients. Yet in the Late Jurassic offshore Nova Scotia, the large Sable Island paleodelta and the thick Abenaki carbonate shelf with coral reefs are contemporaneous. Two different shelf morphologies are associated with the respective bodies – prograding ramp for the delta and its thin interbedded limestones versus steep-sloped platform for the carbonate shelf to the west. Microbial mud mounds are common in deeper water and slopes of the Abenaki margin showing a consistent pattern of changes depending on their distance from the Sable Island delta. This is most readily seen in color changes that reflect closely J.L. Wilson's (1975) observation that "sedimentary rocks have three significant colors - dark, light and red"! The slope sediments in the most distal Albatross B-13 are cyclic red and whites and may represent some of the geologically youngest red stromatolite mud mounds that had their acme in the mid-Paleozoic. Slope colors become increasingly dark more proximal to the delta. And within the delta, cores in Penobscot L-30 and South Venture C-62 show both dark colors and limited biotic diversity. The C-62 cores are particularly interesting because they give an independent check on the shelf margin delta model and sequence stratigraphic scenario presented for the Venture gas field by Cummings and Arnott (2005). Changes from a biotically depauperate marl up into a microbial mud mound then an argillaceous sponge reef mound with some stromatoporoids and possible red algae in less than 7 meters reflect a forced regression and falling sea level. This can be fitted well to the published deltaic sequence stratigraphy as long as it is appreciated that the "condensed limestone facies" is actually a distal composite recording of changes in sea levels, nutrient supply and ultimately sediment type that replaces the carbonate as the delta progrades. As well the maximum flooding surface is during the microbial mound stage below the abrupt change across a pyritized hardground upward into laminated black shale. This reflects problematic differences in sequence stratigraphic concepts as applied to carbonates versus siliciclastics. Relative to understanding the Abenaki platform, C-62 core gives insights into the relationships seen only in cuttings and sidewall cores in Queensland M-88 which drilled the slope and basin immediately in front of the Deep Panuke gas field in the Abenaki. M-88 and C-62 also hold some promise to be potential links for correlating and dating the massive carbonates and the Sable Island deltaic siliciclastics. Relative to the thick siliciclastics, it shows the utility of thin carbonates to be sensitive indicators of the surrounding sand and shale sedimentation.

A conceptual model of horse mussel reef formation, Bay of Fundy, Canada

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Horse mussel reefs (bioherms) in the inner Bay of Fundy continue to be the focus of study. Research indicates that populations grow fastest on sand with bioherms, closely followed by those growing on gravel/scallop bed; the slowest growing are found on gravel/ cobble and mottled gravel geological provinces. Multibeam bathymetric and backscatter data have been collected in an area of mussel reefs in the central part of the Bay where they were first discovered. The data indicates that the mussel reefs largely occur on the eastern side of small glacial ridges of the seabed and form a variety of single and multiple, long and short reefs that rise above the seabed up to 3 m high. They are associated with sand in transport at the seabed in a variety of bedforms. A conceptual model of formation and location has been developed that considers sediment transport, current velocity and turbulence, well-mixed water masses, seabed morphology, and sediment distribution.

The presence of limited amounts of sand in transport as well as the location of minor morphological features (glacial till ridges) is critical for reef formation. As the horse mussels become gradually surrounded by sand, upward growth is promoted and successive generations of horse mussels build on top of the older and dead shells. The location of the reefs on the east side of the ridges results from ridge vortices that are formed during flood conditions on the eastern side as spiral vortices with horizontal axis. This provides increased sestion to the back ridge regions with associated lower velocity water flows that would encourage the formation of the horse mussels reefs.

Geology of the Ice Cu-Au deposit, Yukon

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The Ice copper-gold deposit is located in the Carmacks copper belt, UTM zone 08V, 417935E, 6905900N, Yukon. First staked in the early 1970s, it is being explored by BC Gold Corporation of Vancouver. Exploration has focused on the eastern edge of a bulls-eye positive aeromagnetic anomaly, measuring roughly 1000 m by 700 m. The Carmacks copper belt contains economic porphyry-type copper type deposits, such as the Minto and the Carmacks Copper. This study is based on field mapping, petrography, ore microscopy, microprobe analyses and rock geochemistry. It reviews exploration history in the context of genetic models and the known geology of other deposits in the region.

The Ice surficial rocks studied so far contain malachite and other copper oxides in pores and fractures, probably previously occupied by sulphides. Small irregular particles of gold and silver are present. Disseminated magnetite partially oxidized to hematite (martite) accounts for the relatively high magnetic susceptibility of the rocks. The low-grade copper is hosted in variably sheared and altered hornblende-biotite granodiorite phases of the early Jurassic Granite Mountain Batholith. Fabrics and recrystallized quartz veinlets suggest that hydrothermal mineralization preceded deformation. It is suggested that, as previously established for the Minto and Carmacks Copper, the Ice deposit formed in the Jurassic at considerable depth (> 5 km) in a porphyry copper system, and that tectonic deformation (ductile shearing) followed the main mineralization event. Exhumation and extensive weathering occurred in the Cenozoic.

Four Billion Years and Counting: a book to celebrate Canada's geological heritage and International Year Of Planet Earth

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In 2006, the proposed multi-authored, popular book, "Four Billion Years and Counting: Canada's Geological Heritage" was identified as one of Canada's primary contributions to International Year of Planet Earth (IYPE, 2007-2009). To achieve this goal, a seven-person editorial board is marshalling the work of more than fifty expert contributors in order to publish both English and French editions in late 2008. Initial chapter drafts are now being woven into a narrative that will make sense to the reader and be coupled with new graphics and hundreds of contributed photographs. The book will highlight Canada's fascinating geological record, spanning the last four billion years. Canada has some of the oldest rocks on Earth, a record of the break-up and reassembling of land masses, and spectacular modern geological features such as mountains, canyons, waterfalls even volcanoes. Equally vital is Canada's wealth of minerals and energy resources, and its changing climate over the eons. The book's first few chapters will explain such basics of geology as plate tectonics, geological time and the fossil record. This section will be followed by eleven chapters outlining Canada's geological evolution in a series of time slices. Novel paleogeographic maps are being developed to illustrate how the geography of Canada has changed over four billion years. The final section of the book, Health and Wealth, looks at ways in which geology directly affects Canadians and covers mining and

energy, health, and the future. “Four Billion Years and Counting” should appeal to the non-geologist, and also attract the attention of geologists interested in regions or topics outside their specialty. The book will include a number of “hooks” to capture readers’ attention, such as attractive photographs, paintings and schematics, and an easy-to-read text that will have been reviewed by specialists (for accuracy) and non-specialists (for readability). It’s an ambitious project but one that will be a worthy legacy of International Year of Planet Earth.

Climate-change impacts and adaptation: a coastal geoscience perspective

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Projected global surface temperature changes over the coming century range from 1.1-2.9 °C to 2.4-6.4 °C depending on the emissions scenario, a function of the development pathway (IPCC Fourth Assessment Report, 2007 [AR4]). At constant year 2000 GHG concentrations (i.e. irrespective of future emission reduction accomplishments and not accounting for 2000-2008 emissions growth), the existing commitment to warming is $0.6 \pm 0.3^{\circ}\text{C}$ (all projections for global mean at 2090-2099 relative to 1980-1999). Changes are projected in a range of other climate variables, including precipitation and water balance, storm intensity, ocean circulation, and sea levels. For the same time frame and scenarios, the projected rise in global mean sea level ranges from 0.18-0.38 m to 0.26-0.59 m, compared to the observed sea-level rise over the past 50 years equivalent to 0.18 m/century (AR4). In other words, sea level will rise at least as fast as in the past and likely faster. In Atlantic Canada, the apparent rise in mean water level against the coast is amplified by widespread crustal subsidence. Sea-level rise over the past century has already increased the frequency of coastal flooding in this region, with implications for coastal erosion and shoreline change. Coastal erosion rates are spatially and temporally highly variable, but rising sea levels, increased storm intensity (with associated storm surges and waves), and reduced extent and duration of sea ice are likely to produce accelerated erosion. Rates of coastal wetland loss may increase, in part due to structures preventing landward migration, and salt-marsh biodiversity may be diminished (AR4). Population growth in coastal areas, combined with rising property values, leads to increased vulnerability in some regions including Atlantic Canada, where the current level of adaptation is predominantly poor and uneven. Thus we are already challenged by the existing climate and ill-prepared for faster change. Our conventional development practices are often maladaptive. Vulnerability depends on the timing and effectiveness of adaptation and on coping capacity (AR4). The latter can vary widely and often depends on individual champions as well as economic and technical resources and institutional arrangements. In this context, as for geohazard mitigation, geoscience expertise can play a key role limiting vulnerability. Examples include measurement and modelling of vertical motion, estimates of past and future sea-level rise, detailed topographic data and flood projections, and understanding of coastal response processes, enabling informed projections of future environmental change. Sound geoscience and geomatics information is a critical foundation for robust adaptation. Through establishment of collaborative partnerships between scientists and planners, geoscience can inform policy development and the planning process in coastal communities, thereby enhancing resilience in the face of a changing climate.

Late Paleozoic felsic volcanic rocks in southwestern New Brunswick: relevance to uranium mineralization in the region

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Uraniferous felsic volcanic and volcanoclastic rocks of the Late Devonian Harvey Group occur along the northern margin of the Maritimes Basin in southwestern New Brunswick. The group crops out as an elongate belt 16 km long and 2 km wide, comprises the base of the Devonian-Carboniferous basin in that area and has been stratigraphically and petrographically correlated the rocks of the Piskahegan Group of the Mount Pleasant Caldera on the southern margin of the basin.

The Harvey Group has been subdivided into three formations: York Mills, Cherry Hill and Harvey Mountain. The York Mills Formation (~60 m thick) includes sedimentary rocks, lithic tuffs and rhyolites frequently containing cavities lined with quartz and fluorite crystals. The Cherry Hill Formation (~100 m thick) contains mainly two ash-flow sheets accompanied by ash-fall tuffs and quartz-feldspar porphyry. The Harvey Mountain Formation (75-150 m thick) is composed mainly of rhyolites that are intercalated with minor ash-fall tuffs and contains fluorite as a groundmass mineral and in cavities. The uranium mineralization mainly occurs in the Harvey Mountain Formation as pitchblende associated with sulphides in fluorite veins and veinlets.

The Harvey felsic volcanic rocks are high-K peraluminous F-rich rhyolites. They are high in SiO₂ and alkalis with K₂O/Na₂O > 1 and low CaO, TiO₂ and P₂O₅. Compared to typical calc-alkaline rhyolites, the Harvey volcanic rocks are enriched in Rb, U, Th, Nb and Y but depleted in Ba, Sr and Zr, in addition to Ca, Ti and P, features typical of highly evolved rhyolites. The Harvey felsic volcanic rocks share many similarities with uranium-rich topaz rhyolites of the southwestern USA and topaz granites that are commonly associated with U-mineralization, although topaz has not yet been found in the Harvey volcanics. These features indicate the Harvey volcanics could either represent more fractionated facies of the Piskahegan volcanics or they are not co-magmatic.

The Harvey felsic volcanic rocks are a result of an extensive fractional crystallization where fluid fractionation played an important role in late-stages of magmatic differentiation. Although not yet known, these rocks could be a source for uranium mineralization in the younger Carboniferous sedimentary strata upon their erosion. Continental tholeiitic basalts, which are

associated with both the Harvey and Piskahagan felsic volcanics are mantle-derived. They probably represent a heat source which triggered a partial melting of metasedimentary crustal material producing felsic magma. Basaltic magma was probably emplaced into the crust at the early stages of lithospheric extension associated with the basin formation. The high K content and peraluminous nature of the felsic rocks also point to a metasedimentary source, probably containing metapelites.

Geographic Information System for terrestrial analogue research and planetary databases

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The Canadian Space Agency (CSA) is involved in several space exploration research projects carried out through the Canadian Analogue Research Network (CARN). All these projects require the visualization, manipulation, analysis, and interpretation of geospatial terrestrial information for comparison with the existing planetary databases. The large amount of data gathered through these projects require easy access and processing ability for principal investigators and their students at Canadian universities, CSA staff, and stakeholders in government, industry, and at space agencies worldwide.

We present the results of a project in development to create an Internet-based Geographic Information System (WebGIS) for terrestrial analogue research and planetary databases at the CSA. The project has three objectives: (1) to promote and facilitate research at analogue sites in Canada; (2) forge stronger links with the international earth and planetary science community by sharing geospatial information and (3) give visibility to the CSA in the field of analogue and planetary database management.

For this project, we are testing an OpenGIS architecture made available on the Internet and built according to the international standards developed by the Open Geospatial Consortium. In addition to reducing costs, this approach allows: (1) flexibility in database management, (2) interoperability with a Web Map Service (WMS), (3) the ability to create multilayered databases and queries for comparative studies, and (4) regular updates to include data from ongoing terrestrial analogue and planetary missions. Similar solutions already exist but are largely dedicated to terrestrial databases except in a few cases for global planetary information. The particular feature of the proposed WebGIS solution will be to focus on a detailed comparison of terrestrial and planetary geospatial databases using a list of specific queries developed in collaboration with experts from the scientific community in Canada and internationally.

Paleolithic to Neolithic sites in the Belan Valley of India: early agriculture under an unstable monsoonal climate following the Last Glacial Maximum

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Considerable evidence is emerging that early human settlement and migration across Asia and Europe were influenced by rapid climate changes, as global climate adjusted to reduced ice cover following the Last Glacial Maximum. Along the Belan River in northern India, archeological sites have yielded a remarkable assemblage of Paleolithic to Neolithic settlements, with evidence for some of the world's earliest agricultural activity including Neolithic rice cultivation and domestication of animals.

Alluvial strata in the Belan valley yield dates between 85 and 72 ka B.P., implying sustained fluvial activity in Marine Isotope Stage 5 and later, probably under active monsoonal conditions. However, the youngest channel fills below the settlements were abandoned and filled with windblown silt with shell fragments, interbedded with fluvial sediments. Mounds of shell-bearing silt lie inland from the river. Five OSL dates for the channel fills and mounds span the 14 to 7 ka B.P. period, corresponding broadly to the period of Mesolithic settlement. Above the eolian beds, the main Neolithic settlement rests on floodplain muds, indicating renewed fluvial activity.

The Belan eolian material has a small volume and reflects local deflation of sediment from the nearby river. However, no eolian deposits were observed in the older strata, and the post-LGM period was probably unusually dry in the Belan area. We suggest that the Mesolithic settlements developed against a backdrop of regional climatic instability, with periods of active river flow and drought. This would have been a difficult time for agriculture. In contrast, Neolithic sites were probably established during a period of more intense monsoon rainfall after about 7 ka, when stable agricultural settlements could have been established and rice cultivated.

A unique Neoproterozoic to Cambrian trace fossil assemblage from the Goldenville Group, southwestern Nova Scotia.

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The High Head member is a ~860 m interval of fine-grained metasedimentary rocks, in the middle of the generally sandy Goldenville Group of southwestern Nova Scotia. The stratigraphy is punctuated by only rare coarser sandstone beds, and one interval of mafic intrusions, which appear to have been intruded while the sediments were still wet. Paleocurrents, deduced from flutes and grooves in the immediately underlying sandstone beds, and from rare washed-out ripple marks that are the

largest physical sedimentary structures in the mudrocks, show flow towards the south and west, in contrast with paleocurrents recorded from Atlantic coastal outcrops of the Goldenville Group, which are almost all toward the north or east.

The High Head member contains spectacular trace fossils. In the lower part of the section, the trace-fossil assemblage comprises *Oldhamia radiata*, large, sparsely branching *Chondrites acutangulus*, *Curvolithus sp.*, *Gordia sp.*, *Planolites sp.* and *Taenidium sp.* Up-section, large *Glockerichnus sp.* are also rarely observed. Near the middle of the section *Trichophycus pedum* (formerly known as *Phycodes pedum*) is commonly observed. Also present are taphonomic variants of the *Trichophycus pedum* (i.e. *T. pedum* truncated and preserved at a different level); they appear as evenly spaced, reamed intrusions that some researchers have referred to as *Hormosiroidea*, *Saerichnites* or *Neonereites uniserialis*. The upper half of the section is bioturbated sporadically, and dominated by *Gordia marina*, *Helminthopsis sp.*, *Taenidium sp.*, and rather persistent, if rare *Phycodes sp.* and *Trichophycus pedum*. Thick sand beds characterize the uppermost part of the High Head section and trace fossils become rare in that area.

Of interest in the High-Head ichnology is: (1) the relatively high diversity of trace fossils observed; (2) the presence of *Trichophycus pedum*; and (3) the occurrence of *Gordia marina* with *Trichophycus*. The observed assemblage is very similar to those in late Precambrian to Early Cambrian sequences of southeastern Newfoundland (Chapel Island Formation), which yielded (in common with the Goldenville Group) *Curvolithus sp.*, *Gordia sp.*, *Neonereites uniserialis*, *Phycodes pedum*, *Planolites sp.*, and *Skolithos sp.* In Newfoundland, the diverse ichnofaunas were reported below the oldest trilobite-bearing strata. *Trichophycus* has been reported almost globally, with its first occurrence in strata with or immediately above Ediacaran fossils. *Trichophycus pedum* is taken to indicate the presence of the first well-developed, metazoan animals, and thereby indicative of the boundary between Precambrian and Phanerozoic strata. The occurrence of *Trichophycus pedum* and the similarities of the observed assemblage suggest that the High Head exposures may indeed straddle the Precambrian-Phanerozoic contact.

Summary of the Nova Scotia component of the North American Soil Geochemical Landscape Project

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The objective of the North American Soil Geochemical Landscape Project (NASGLP) is to establish a continental framework of inorganic, organic and microbiological soil geochemical data and to ensure the data are available to a wide range of applications, issues and disciplines. The project is a tri-national initiative that involves the co-operative efforts of the federal, provincial and state geological surveys of Canada, the United States and Mexico, and will result in the first-ever continental-scale map of the geochemistry of North America based on 13,215 sample sites yielding an overall sample density of 1 sample per 1600 km².

All sampling protocols, including (1) identification of the various soil horizons to be sampled, (2) the type, number and size of samples to be collected, (3) the type and proper use of accepted sampling equipment, (4) laboratory preparation and (5) analytical procedures were designed by the Geological Survey of Canada in conjunction with numerous partners, including the National Forestry Service, Agriculture Canada and Health Canada.

The 2007 field season began in early June with a one week field orientation program in the Amherst area to introduce the Nova Scotia sampling team to the field equipment, sample data sheets and identification of the various soil horizons to be sampled. Fifty-four sites across the province were sampled (and three field duplicates were collected for a total of fifty-seven samples). All samples were collected by shovel from hand-dug pits averaging approximately 90 cm in depth. Detailed field descriptions including sample depth, colour, redoximorphic features, texture, clast type/percentage and root size/quantity were recorded for each site. A digital photograph of the site was taken and annotated for future reference. Sample sites were geo-referenced (NAD 83) by GPS to the Universal Transverse Mercator (UTM) grid (Zone 20).

In addition to collecting soil samples for geochemical analysis, measurements of (1) soil gas radon, (2) radiometrics (U, Th, K, and Total) and (3) soil permeability were also collected at each site. Soil samples were also collected to determine bulk density and/or moisture content.

Analytical results are expected in the spring of 2008. Funding for the project was provided by Natural Resources Canada (Geological Survey of Canada) and Health Canada.

What are Hoodoos and how do they form? Cosmogenic nuclide insights into Holocene landscape evolution in the Colorado Plateau

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Recent dendrological, stratigraphic, ecological and soil-geomorphic studies of catchment-scale landscapes associated with weakly cemented soil-mantled weathering-limited slopes of Jurassic sandstones in northeastern Arizona have indicated that minor climate changes can strongly influence landscape evolution by controlling the rates of erosion. To test this hypothesis, direct measurement of slope erosion is needed. Terrestrial in situ cosmogenic nuclides (TCN) provide a means to directly establish slope retreat history in the Blue Gap region of Arizona. There, hoodoos (or tent rocks) capped with resistant concretions which protect the underlying sandstone from erosion, form along actively retreating slopes. Exposure of the hoodoo begins as the concretion is exhumed and separated from the retreating slope. The hoodoos occur predominantly in

basins where the slopes are steep ($>25^\circ$), soil is thin, and rapid surface runoff retards weathering rates. Here, successions of hoodoos extend as far as 200 m from cliff faces and are ideal erosion markers to track slope retreat in multiple basins where dendro-stratigraphic weathering and soils work has been completed.

Surface samples from the tops of eleven concretions on hoodoos up to 8 m high were analysed for cosmogenic ^{10}Be in quartz. The durations of concretion exposure range from 400 to 5800 years, and in all basins the ages increase with distance from the slope. This is the first time hoodoo development has been dated. The corresponding slope retreat rates range from 3 to 10 mm/a support the hypothesis of a strong climate sensitivity of slope erosion in arid regions and provide insight into the development of arid region landscapes with and without the presence of caprocks.

Chlorite diagenesis in reservoir sandstones of the Lower Missisauga Formation, offshore Nova Scotia

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Diagenetic chlorite rims on quartz grains preserve porosity by preventing the formation of secondary, pore-filling quartz overgrowths in wells from the Venture and Thebaud fields. Elsewhere, in the Norwegian Sea and the US Gulf Coast, such chlorite rims have been interpreted as an early burial diagenetic feature related to the input of iron from rivers or volcanic activity, or to later diagenesis by basinal fluids. The purpose of this study is to evaluate which hypothesis is applicable to the Scotian Basin.

A set of 45 sandstone samples from conventional cores were analyzed for mineralogy in thin section, mineral composition by electron microprobe, whole-rock chemistry, and X-ray diffraction.

From analytical data, it can be argued that a precursor iron-rich clay has diagenetically altered to form chlorite rims during early burial diagenesis, before widespread precipitation of pore-filling kaolinite and quartz overgrowths.

The depositional environment, including the degree of bioturbation, may influence formation of early Fe-rich clay coatings. The quality of the final chlorite rim depends on the sea floor diagenetic environment, apparent from the correlation between the quality of chlorite rims and phosphorus. The conditions that favour precipitation of phosphate must also result in Fe-rich clay coatings and may also make some coatings a better precursor than others for the conversion to chlorite during burial diagenesis. The presence of other Fe-rich minerals may also indicate an abundant supply of iron in the early diagenetic environment.

Impact cratering: A planetary process as seen from Earth

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Planetary exploration highlighted impact as a ubiquitous solar system geologic process for surface and upper crustal modification, particularly in early solar system history. The Earth, however, is the most endogenically active of the terrestrial planets and has the poorest preserved record of impact cratering, with the current known sample consisting of ~ 175 structures or crater fields and ~ 20 events in the stratigraphic record (some of which are related to known structures). The sample is biased towards (<200 Ma), large (>20 km diameter) impact structures on the geologically better-known cratonic areas, which has implications for cratering rate estimates and claims for periodic or clusters of impacts. This relatively small, biased sample, however, plays a critical role in understanding cratering process, as it is the only current source of ground truth data on the third dimensional structural and lithological character of natural, large-scale impact craters. Observations at terrestrial impact structures have led to such fundamental concepts as: shock metamorphism (including impact melting) and its attenuation, formation of a transient cavity by the cratering flow-field, and subsequent modification of this cavity, including structural uplift to form a positive topographic feature in large complex craters. Observations at the three largest structures: Vredefort, Sudbury and Chicxulub are consistent with models of peak ring formation but the models can not be independently confirmed, due to the small sample. While terrestrial structures were initially studied to understand impact as a planetary process, impact has also played a role in Earth evolution. Biological evolution was affected directly through the Chicxulub impact 65 Ma ago and the associated mass extinction. More important, however, was the formation of the Earth's moon as the result of a massive impact on the proto-Earth, which resulted in lunar tides and the creation of littoral zones to the world's oceans. On the time-scale of a million years or less, relatively small impacts are a continuing threat to the long-term survival of human civilisation. The creation of large, localized thermal anomalies and specific structural and morphological forms has resulted in historical and current economic quantities of natural resources in ~ 25% of terrestrial craters and related deposits. Some of these are world-class, e.g., Sudbury, Vredefort and the Campeche Bank oilfield, with the net result that impact structures produce ~ \$20 B of natural resources per year. Although no rocks are preserved on Earth from the time of the heavy bombardment of the moon, a similar bombardment, scaled to terrestrial conditions, would have resulted in major remelting of the Earth's early crust. Thick impact melt sheets differentiate and such massive remelting would have led to secondary, felsic differentiates from basaltic materials of the early crust. Thus, these early massive impacts could have played a role in establishing the crustal dichotomy of felsic (continental) and mafic (oceanic) crust that distinguishes the Earth from the other terrestrial planets.

Evidence from fluid and melt inclusions for synchronous sulfide melt oxidation and aqueous-carbonic fluid exsolution in intrusion-related gold deposits

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Granitic rocks within the giant intrusion-related Au-Bi-Te deposit at Fort Knox, Alaska contain a well-preserved inclusion record of magmatic-hydrothermal transition and processes that were potentially critical for the development of the sheeted ore system. Early magmatic titanite grains contain (in their cores) inclusions of an iron sulfide melt that were trapped coevally with silicate melt inclusions at a minimum temperature of 780 °C (based on O₂ geobarometry). Textural and mineralogical evidence indicates that this sulfide melt phase was stable until a relatively late stage in the crystallization history of the granites, but was destabilized due to a progressive increase in oxygen fugacity. Laser ablation ICP-MS analyses of the sulfide melt inclusions show that they contain between 200 and 1800 ppm Cu, and concentrations of Ag, As, Bi, Sb, Te, W, Mo and Ni in the 10-100 ppm range. Notably, Au was detected in the sulfide melts at concentrations in the 1-3 ppm range. Analyses of the coeval silicate melt inclusions allow the calculation of sulfide-silicate melt partition coefficients. Values of D(sulfide/silicate) are between 10 and 100 indicating that the sulfide droplets would have contained the majority of the ore metals present in the system while they were stable. Remarkably, selected metal ratios in the sulfide melt droplets (e.g., Bi/Au) are identical to those in the sheeted ore veins at Fort Knox, suggesting that the sulfide melts. This would suggest that ore-forming processes that occurred after the destabilization of the sulfide droplets (i.e., silicate melt-fluid partitioning, and metal coprecipitation) did not fractionate the ore metals from one another. Textural evidence shows that during titanite growth, apatite saturation occurred. Apatite grains trapped coexisting primary inclusions containing silicate melt and a low salinity (~ 4 - 6 wt% eq. NaCl based on clathrate melting temperatures), aqueous-carbonic fluid (CO₂ ~ 21-39 vol%). These coeval melt and fluid inclusions in apatite provide unambiguous evidence for the saturation of the granitic magma in fluid phase. The fluid inclusions decrepitate at ~ 400 °C; however, apatite-biotite halogen exchange thermometry indicates that the inclusions were trapped at a minimum T of 560-680 °C.

The results show that ore-forming granitic magmas were saturated in a Au-Bi-Te-rich sulfide melt phase. Resorption of the sulfide melt appears to have coincided with saturation of the crystallizing magma in a low salinity aqueous-carbonic fluid. Sulfide melt that persists to a relatively late stage of magma crystallization may act as an important storage phase for ore metals, preventing the loss of ore metals to (i) fluids that exsolve early on when the magma is insufficiently brittle to auto-generate mineralized sheeted veins, and (ii) crystallizing minerals in which metals such as Au are compatible (e.g., magnetite, biotite, titanite). Systematic identification and analysis of sulfide melt inclusions in granitic ore-forming settings significantly “inboard” of convergent plate margins may find application in locating highly mineralized granites and predicting the metal associations and metal ratios to be expected in the ores.

Understanding the origin of deformed Albert Formation sandstone reservoirs: An analogue study with the northeastern Uinta Basin, Utah

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The Albert Formation (Horton Group, Mississippian) of the Moncton Basin in New Brunswick is currently divided into three lithostratigraphic units, two of which are the Frederick Brook Member and interfingering – overlying Hiram Brook Member. These units are interpreted to represent a complex interbedding of lacustrine shale (Frederick Brook Member) with deltaic and lacustrine shoreline sandbodies (Hiram Brook Member). Such sandbodies, some of which are up to 30m thick, have been the successful target for oil and gas exploration in the province. However, the understanding of the original large-scale geometries of these sandstone reservoir rocks remains limited. This is because the Formation has undergone extensive deformation, and its present-day surface exposure is very patchy. Therefore, analogue studies can be a potentially useful tool to improve our understanding of the reservoir.

Greiner, in 1962, first noted the “remarkable resemblances” of the Albert Formation to the Eocene lacustrine formations of Colorado, Wyoming and Utah. For instance, the stratigraphic succession in northeastern Uinta Basin of Utah includes a thick, fine-grained siltstone and oil-shale interval (Green River Formation), overlain by a mixed fine-coarse grained siltstone-sandstone and locally evaporitic unit (Uinta Formation). Interpretation of basal Uinta Formation strata (potentially analogous to the basal Hiram Brook Member) and the nature of its contact with underlying shale and oil shale of the Green River Formation (Frederick Brook Member equivalent) is also complicated by deformation.

The extensive and high quality outcrops in the Uinta Basin permits identification of a localized nature to the deformation at the Green River – Uinta Formation contact. At the meter scale, beds have been dewatered and folded, with large flame structures also punctuating the contact. At the decameter scale, domal and diapiric mudstone structures are common. These structures, which were originally interpreted to represent delta-front clinoforms, appear to be more indicative of flat-lying sheetflood deposits that have been subsequently dewatered and tilted after loading and diapirism, suggesting that Lake Uinta at the time of oil shale deposition subsequently experienced a major base-level fall before any of the observed coarser grained units were deposited. Such an interpretation may be applied as a working model for further investigation of the Albert Formation.

The Severn Estuary (UK): Quaternary investigations and human exploitation

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The Severn Estuary in southwest Britain has, due to its funnel-shaped morphology, the second highest tidal range in the world, second only to the Bay of Fundy in Canada. Interdisciplinary investigations of the Quaternary history of the Severn Estuary has shown that it occurred at the ice-limit, occupying the junction between a Welsh ice-sheet to the north and a periglacial environment to the south. Glacial and periglacial meltwaters were important for channel erosion and deposition of sediments within the basin. Holocene sea-level rise forced a coastal transgression up-estuary, flooding Pleistocene valleys in which marine sedimentation occurred resulting in extensive coastal wetlands. These depositional environments appear to have fluctuated in concert with changes in the rate of sea-level rise, being characterized by marine silt-dominated tidal flat to salt marsh environments during periods of high sea-level rise rates, but becoming peat dominated when the sea-level rise rate decreased. Evidence suggests these wetlands were exploited by prehistoric communities, but were reclaimed during the Roman occupation from AD 43 to 410 and converted to agricultural lowlands, locally known as Levels; reclamation of remaining wetland continued into the Medieval period. Much of the Levels are below the level of high tide and are vulnerable to extreme flooding events, such as in AD 1607 when either of storm surge or tsunami claimed around 2000 lives and caused much socio-economic damage. Sea level continues to rise at a rate of c. 2 mm yr, which places pressure on existing coastal defences. National political debates on sustainable energy are now calling for a tidal barrage to be constructed across the mouth Severn Estuary, the impacts of which are now initially being discussed.

Graphite thermometry in the Halifax contact aureole

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Intrusion of the South Mountain Batholith at ca. 380 Ma produced a well-developed contact aureole in graphitic slates of the Halifax Formation in peninsular Halifax. Two chemically distinct lithologies (Cunard and Bluestone members) show different mineral isograd sequences. The outer rim of the aureole is defined by the cordierite-in isograd in both units. The andalusite-in isograd appears before the biotite-in isograd in the aluminous Cunard member, while the opposite is observed in the less aluminous Bluestone member. Simple phase diagrams for silicate mineral assemblages suggest that P-T conditions ranged from <400 °C in the outer aureole to >550 °C near the contact, at pressures of ca. 2.5-4 kbar. However, the associated reactions are subject to large uncertainties, making precise P-T estimates difficult. A graphite thermometer has been calibrated from the temperature-dependent progressive evolution of Raman spectra of carbonaceous material (RSCM). The graphite thermometer was applied to several samples along a transect perpendicular to the South Mountain Batholith contact between Halifax Harbour and the Northwest Arm. Temperatures range from ca. 360 °C at the outer limit of the aureole to ca. 570 °C at the contact. This independent assessment of temperature can be used in conjunction with silicate phase equilibria to provide better estimates of P-T conditions within the contact aureole.

Variations in sedimentation rates to the western Gulf of Mexico over multiple glacial-interglacial cycles

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Terrestrial cosmogenic nuclides (TCN) are being used to measure sedimentation rates from two non-glaciated and tectonically quiescent river systems (Colorado and Trinity Rivers) draining into the western Gulf of Mexico. The goal of this study is to provide insight into the magnitude of sediment flux variability over the past 5 million years and to quantify the response of non-glaciated catchments to glacial-interglacial climate change.

Deposits already associated with specific glacial or interglacial intervals in the past 200 ka are the main focus of the climate-response portion of this study; however, older deposits are also being analyzed. Preliminary results have been acquired for one TCN depth profile in the Lissie surface (ca. ~640 ka), and a single shielded sample in the chronostratigraphically well-defined Beaumont surface (ca. ~155 ka) along the Colorado River. Each sample consists of 355-500 µm quartz grains derived from unmixed fluvial sediment. The depth profile consists of five regularly-spaced samples excavated from a gravel pit; the lone Beaumont sample was acquired from a cut bank along the present Colorado River. Cosmogenic ¹⁰Be concentrations were measured with 2σ precisions of ~5% and were used to determine average inherited concentrations of $1.6 \pm 0.1 \times 10^5$ atoms g⁻¹ for the Lissie surface, and $2.9 \pm 0.2 \times 10^5$ atoms g⁻¹ for the Beaumont surface. Monte Carlo simulation of TCN concentration vs. depth allowing parallel variability in erosion rate, exposure age, bulk density, and inheritance indicate an insensitivity of inheritance to these other parameters. The optimized inherited concentration corresponds to a basin-wide average erosion rate of 0.029 ± 0.004 mm a⁻¹ for the Lissie surface. The single shielded sample in the Beaumont surface yields a basin-wide average erosion rate of 0.019 ± 0.002 mm a⁻¹. Integrating these measurements with a digital elevation model of the Colorado River catchment returns sedimentation rates of 6.3 ± 2.8 Mt a⁻¹ and 4.2 ± 0.4 Mt a⁻¹ for the Lissie and Beaumont surfaces, respectively.

Glacial and environmental history of Lake Banook, Dartmouth, Nova Scotia, Canada

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Lake Banook in Dartmouth, Nova Scotia is an 11.5 meter deep glacially carved lake created during the Wisconsin glaciation and is located within a regional meltwater corridor. A small-craft geophysical survey was conducted on the lake during summer and fall of 2007, with methods including multibeam bathymetry, sidescan sonar, high resolution seismic (10 kHz) and underwater video data. The seismic character of the different units were used to define different facies spatially and temporally within the lake basin. Sub-bottom profiles show acoustic basement overlain by up to 10 m of well-stratified sediments mimicking the topography of the basement. This is in turn overlain by a ponded, weakly stratified unit up to 4 m thick. The acoustic basement is interpreted as basal till, correlated to onshore drumlins and tills. The well stratified sediments are tentatively interpreted as glaciolacustrine. A local unconformity at their top may be deglacial low-stand or flood related. Sub-basins in the lake show facies and thickness variations which may be influenced by ice configuration. The ponded uppermost unit shows some temporal evolution and potential for links with microfossil studies from nearby Penhorn Lake. Glacial boulders are common between the present lakeshore and 5 m water depth. These are likely washed from the till and will help constrain the low stand. Geological features include drumlinization, overdeepening, fluvial channels, paleo-shoreline, shallow gas, and slumps or debris flows. Observed biological and anthropogenic features in this study may be useful in understanding the more recent processes in the area. Freshwater mussels, bacterial mats, and abundant water plants were found in shallow areas less than 3 m. The degree of anthropogenic impact from deforestation, urbanization, and flooding from construction of the early 19th century Shubenacadie Canal can be assessed from these data. Recent dredging provides a baseline for very recent sedimentation and biological recovery rates. Future work will characterize the lake sediment geometry and stratigraphy, and will include coring for lithologic, environmental, and chronological control.

Getting geology into the grade IV classroom: The FENOREX collection

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Geological and mining societies and institutes have always been concerned about supplying competent young scientists and engineers to sustain the mining and environmental sectors. This concern has been more evident during the recent cycle of global mineral exploration and mining activity. The supply shortage is exacerbated by the short-term approach by industry and governments who do not tend to look beyond a 2-3 year window of technical requirements. Universities have a responsibility to alleviate this problem which could help cure the feast-and-famine cyclic nature of enrollments. This presentation will examine an individual, grassroots approach which may help solve this problem by consistently sparking interest at the elementary school level. This idea is not original. It has been modified from EdGeo and other professional programs. You cannot begin to educate students if the teacher has not been exposed to the subject they are to teach. Therefore, this presentation will demonstrate one method of getting rock and mineral collections into the classrooms to assist these teachers. We will examine the concept of phenomenology as a teaching style, a methodology which initiated this project. To date, 17 local Cape Breton consulting, construction and well drilling companies as well as the Strait-Highlands Regional Development Agency have purchased and placed 39 collections in 35 Grade IV classes in the 2 Cape Breton Island school boards. Response by teachers is extremely positive. Grade VII and XII classes are the next target market. Over the past 3 years, a total of 140 kits have been distributed across Canada. This idea works because it has been created with passion and an entrepreneurial spirit.

Old marine seismic and new satellite radar data: exploring for petroleum in the northern Frontiers

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This paper provides a review of hydrocarbon discoveries and presents some new concepts in the petroleum systems of the offshore northern Labrador Shelf and Baffin Bay region in eastern Canada. The focus of this work was the Hekja O-71 gas discovery of 1979, one of only five wells drilled between 1976 and 1980 from an area covering some 166,000 square kilometres, roughly one quarter the size area of Alberta.

This study emerged from the New Energy Options for Northerners (NEON) project, a broad scale re-examination of the petroleum potential of this area “from the crust up” using regional geophysical data sets to complement the usual seismic reflection interpretation and make an integrated compilation.

An opportunity to use SAR (synthetic aperture radar) data from RADARSAT-1 was taken as an exercise to incorporate alternative data sources to support this exploratory review and resource assessment.

Preliminary examination of the final map of interpreted slick-like features was underwhelming, but closer inspection revealed a close correlation of some of these occurrences to several previously overlooked bathymetric features which had underlying seismic signatures similar to previously identified gas hydrate “pipes” or chimney anomalies seen, for example, in data from offshore Nova Scotia and western Ireland. World-wide many active marine hydrocarbon seeps appear on the sea floor as “pockmarks”; in this case no sea floor depressions were seen to be associated with active seepage. Instead, very distinct mound-like structures are seen associated with seeps at two locations.

The seismic evidence of these probable mud volcanoes as the sea floor structures in close proximity to the seepage features observed in the RADARSAT-1 SAR images makes a compelling argument for re-examining additional areas for petroleum prospects as well as the potential for considering new stratigraphic as opposed to purely structural plays in a new exploration fairway.

The carousel: a thinking activity for geoscience outreach enthusiasts

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Generating an awareness of the many linkages between geoscience and people's daily lives is an ongoing challenge for the geoscience community. Geologists can find the absence of understanding somewhat frustrating because they are already aware of society's co-dependence on natural resources. They also know how important it is for everyone to better understand the Earth and our interaction with it. Geologists who are active in education outreach are constantly on the hunt for activities that convey the importance of understanding the Earth in ways that are fun and educational. The carousel activity is a great way for students, teachers and or workshop participants to brainstorm about geoscience topics. Educators can use it to introduce geoscience into the classroom or to help focus a class or group before any unit of study. In the first part of the activity, station facilitators help to reveal what the participants know and understand about pre-determined topics. Any preconceived notions and inaccurate information are also revealed. As the activity proceeds, summaries of each station are shared and discussion ensues. The activity leader or station facilitators must be ready to rectify any inaccuracies in geoscience knowledge. At the conclusion, participants acquire a better understanding of geoscience and they begin to appreciate its role in our daily life. A condensed version of the carousel will be organized for the Colloquium session participants. Participation will not be mandatory but it will be encouraged.

Acoustic velocity and elastic moduli profiles and corresponding fracture density and orientation patterns in artificially shocked granite: preliminary results

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Impact events can be simulated at a small scale in the laboratory and the subsequent crater can be examined to learn more about cratering processes. This work investigates subsurface fracture patterns beneath craters and the relationships between fracture density and orientation and acoustic velocity anomalies. Previous research in the laboratory and larger scale seismic surveys across impact craters on the Earth's surface show that shock damage reduces the compressional wave velocities in the rock. Shear wave velocities measured as a part of this study complement the compressional wave velocities reported in the literature. The collection of a more complete data set allows calculation of V_p/V_s ratios and the derived elastic moduli profiles across an artificial crater produced by the Lindhurst Laboratory of Experimental Geophysics at the California Institute of Technology, Pasadena, California. Preliminary results show that shear wave velocities are more sensitive to the presence of fractures and resolve more widespread damage than compressional wave velocities, thus shear wave velocities or V_p/V_s ratios can be used to map a more complete picture of impact induced damage. Shear wave velocity measurements in three directions show anisotropy which has been attributed to the presence of different fracture populations and orientations. Future work will compare crack orientation in more detail with acoustic velocity and elastic moduli profiles; thin section observations will allow better characterization of fracture populations. Results from this study have implications for understanding cratering effects on solid surfaces throughout the solar system.

Cement timing and distribution in Lower Cretaceous sandstones: Glenelg, Thebaud and Chebucto fields, offshore Scotian Basin

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Diagenetic cements have been studied in conventional core of Lower Cretaceous sandstone from the Glenelg, Chebucto and Thebaud fields in the Sable Subbasin, offshore Nova Scotia. The spatial and temporal distribution of diagenetic cements and para-sequences has been constrained in relationship to lithofacies, depth and the well position in both the distal (Glenelg and Chebucto) and proximal (Thebaud) parts of the basin.

Clay minerals in the sandstones include early grain-coating clays, kaolin, illite and chlorite. Grain-coating illitic clays occur in Glenelg N-49 forming coated grains cemented, initially, by Fe-rich calcite (CI), then low Fe-calcite (CII). Kaolinite occurs as booklets and vermicular stacking textures. It fills large intergranular pores in the Chebucto well and in some samples from Thebaud I-93 and Thebaud #3. Kaolinitized mica exhibits expanded texture that inflates into adjacent intergranular pores. Illite occurs also as fibrous crystals, which in the Chebucto K-90 well are included by ankerite. Fe-rich chlorite (chamosite) rims are found only in the Thebaud samples examined and demonstrably have developed from earlier Fe-rich clay. Early pore-filling chlorite occurs in contact with detrital quartz and lithoclast grains and is often associated with illite. Both this chlorite and chlorite rims are formed around quartz grains lacking quartz overgrowths. Quartz cement (overgrowths) is well developed principally in medium and coarse sandstones. It postdates kaolinite cement and predates most of the other cements.

Carbonate cements (calcite, Fe-calcite, Mg-calcite, ankerite and siderite) are the major cementing minerals filling the large intergranular pores in Glenelg, Chebucto and Thebeaud wells. In Glenelg H-59, two siderite cements were defined; the earliest one is formed by large and corroded crystals and it is low in Mg. The late microcrystalline siderite ($< 10 \mu\text{m}$) is Mg-rich (8 to 9%). It forms the tiny crystals that fringe detrital grains and fill intercrystalline micropores between quartz and Fe-calcite cement. In Thebeaud I-93 siderite nodules contain less Mg than the siderite cement (1%, 8.5% respectively).

The neo-formation of framboidal pyrite in carbonate cement indicates a burial under both reducing and alkaline conditions. In samples from the Glenelg field, perthite is partially replaced by Fe-calcite, with only K-feldspar patches and albite left. Rare traces of francolite (samples with 1 to 6 wt.% P_2O_5) are found in the Glenelg wells associated with illite and calcite cements.

These observations on diagenetic minerals are related to the position of host sediments within parasequences. Coated grains are restricted to transgressive system tracts. Abundant early kaolinite and siderite are found principally in sandstones immediately beneath transgressive system tracts, particularly in cross-bedded coarse channel sandstones. Early calcite cement, predating quartz overgrowths, is found principally in bioturbated sandstones and mudstones with bioclasts, typical of the HST.

Reservoir quality, diagenetic history and provenance of the Late Triassic sandstones of Wolfville Formation, Cambridge Cove, Bay of Fundy, Nova Scotia

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The sandstones of the Triassic Wolfville Formation at the Cambridge Cove at the Bay of Fundy were investigated petrographically. The study included grain size analysis, diagenesis, porosity, heavy mineral analysis and reservoir characteristics depending on these properties. These studies indicated that these fluvial sandstones are calcite cement-supported feldspathic litharenites to lithic felsarenites. They consist of quartz (33.6%), lithics (17.3%), feldspars (9.8%), minor amounts of mica and heavy minerals (2.6%) and cement (36.7%). The sandstones have a recycled orogenic provenance derived from metasedimentary and granitic rocks postdating the collision type setting and during the early stages of rifting. Their heavy minerals consist of iron oxides (76%), garnet (13.6%), apatite (3.3%), chlorite (3.3%), zircon (1.4%), tourmaline (1.3%), biotite (1%) and few others. The main sources of these deposits are the Early Paleozoic Meguma Supergroup, South Mountain Batholith and the carbonate rich Carboniferous formations exposed in Nova Scotia, with possible minor contribution from the Appalachian Mountain exposures in New Brunswick. The Wolfville Formation, which is overlain by the Blomidon Formation, has limited exposed area relative to its wide subsurface extension beneath the Bay of Fundy, where it is underlain by the Horton Bluff Formation in the Minas Basin area, and by Meguma and/or Avalon Zones in the southwestern parts of the Bay of Fundy. The Wolfville sandstones have a porosity ranging from 2 to 17% which gives it the potential to be a moderate to good reservoir rocks for hydrocarbons, especially where it overlies the potential source rocks such as the organic-rich shales of Horton Bluff Formation, or other younger shales within the Mesozoic rocks in the subsurface section beneath the Bay of Fundy.

Microlite in the Greenbushes pegmatite, Western Australia

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The Greenbushes rare-element pegmatite, Western Australia, is currently mined for lithium and tantalum and is among the largest tantalum producers in the world. Although tantalite is the dominant ore mineral, more than ten other tantalum-bearing phases have been reported. The tantalum-rich pyrochlore, microlite, has been identified in mill concentrates at the Greenbushes mine, however its paragenesis is not well documented. In the present petrographic investigation of different zones within the Greenbushes pegmatite, microlite was discovered within a fine grained assemblage of quartz, albite and fluorapatite in the border zone near the footwall contact of the pegmatite. It occurs as equant, anhedral to subhedral grains that are generally less than 0.5 mm in diameter. The grains are pale yellow in plane polarized light and sometimes contain small inclusions of a high birefringence mineral. Optical and backscattered electron images (BSEI) indicate that most individual grains are essentially homogeneous in composition and texture. Raman spectra obtained from Greenbushes microlite closely matches that of stannomicrolite, but electron microprobe results reveal significant concentrations of antimony in addition to tin. Microlite occurs in intensely sheared and recrystallized pegmatite, however, individual grains show no sign of deformation or alteration. We suggest that microlite precipitation is coeval with late deformation and the remobilization of tantalum within the pegmatite. The occurrence of microlite and abundant apatite in the border zone is attributed in part to chemical exchange between the pegmatite and the calcium-rich metasedimentary host rocks.

Correlation of thermo-tectonic and metallogenic events in the Avalon and Meguma terranes of Nova Scotia with the use of $^{40}\text{Ar}/^{39}\text{Ar}$ and Re-Os geochronometry

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The geological evolution of the Avalon-Meguma composite terrane is punctuated with numerous thermo-tectonic events, including widespread magmatism and deformation (e.g., Acadian and Alleghanian orogenies). Associated with these regional

events is fluid flow, localized in the case of magmatism, but more widespread for regional deformation. Herein are presented new geochronological data ($^{40}\text{Ar}/^{39}\text{Ar}$, Re-Os) from mineralized areas in this region that constrains the timing of related magmatic-tectonic events. Results are summarized, progressing from east to west geographically. (1) A Re-Os age for molybdenite from the Coxheath Cu-Au-Mo porphyry deposit, Cape Breton, indicates an age of 626 ± 3 Ma, which compares to 620 Ma $^{40}\text{Ar}/^{39}\text{Ar}$ ages for the host rock. The new Re-Os age, along with the nature of mineralization, confirms this as a rare example of a Precambrian porphyry system. (2) The terrane bounding Cobequid- Chedabucto Fault System has been the locus of episodic deformation, magmatism, fluid flow and mineralization. The age of hydrothermal activity is constrained at two localities, Copper Lake (Cu-Au) and Mt. Thom (Cu-Ni-Co). At the former, concordant ages for hydrothermal muscovite ($^{40}\text{Ar}/^{39}\text{Ar}$, 327 ± 1.3 Ma) and pyrite (Re-Os, 323 ± 8 Ma) were obtained, which agree with $^{40}\text{Ar}/^{39}\text{Ar}$ whole-rock ages for two hydrothermally altered granites (335 ± 5 Ma). (3) Whole-rock slates from gold districts near Halifax were dated with $^{40}\text{Ar}/^{39}\text{Ar}$. Samples in and distal from bedding-concordant quartz veins yielded plateau ages of ca. 375 Ma, thus younger than the age for regional Acadian deformation. That the ages overlap both vein Au formation (Re-Os arsenopyrite = 380 Ma) and 380 Ma granitic plutonism suggest that large thermal anomalies related to vein formation may reflect an underlying heat source (i.e., granites). (4) Mineralization at the East Kemptville Sn deposit is constrained at 376 ± 1 Ma (Re-Os molybdenite), however, the age for reactivation of fault zones controlling ore are unconstrained. Dating of euhedral sanidine from banded zeolite-sulphide fault-fill yielded a 230 Ma $^{40}\text{Ar}/^{39}\text{Ar}$ plateau age. This age may equate to Triassic faulting and sedimentation in the Fundy Basin. (5) Dating of both molybdenite (Re-Os) and hydrothermal muscovite ($^{40}\text{Ar}/^{39}\text{Ar}$) in the Clayton Hill pluton give essentially concordant ages of 363 ± 1.3 Ma and 361 ± 2.3 Ma, respectively. These new data provide evidence for a previously unknown metallogenic event in the Meguma Terrane, possibly associated with A-type magmatism. (6) Re-Os dating of molybdenite from richly-mineralized greisen boulders from the Plymouth area, which initiated the tin rush in SW Nova Scotia in the 1970s, gave an age of 374 ± 2 Ma, hence, similar to the age for mineralization at East Kemptville. This material is, therefore, not related to the nearby 357 Ma Wedgeport pluton.

Winter ice and sediment budgets in upper Fundy

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Extensive winter ice develops routinely in the extremities of the Bay of Fundy: Minas Basin / Cobequid Bay and Cumberland Basin. Much research has been carried out on estuarine ice formation, both in Fundy and elsewhere and these processes are fairly well understood. The relation between winter ice and the estuarine sediment budget, however, is an intelligent guess at best.

Winter ice affects marshes both vertically and laterally. Supratidal marshes are inundated by high tide only at extreme spring tides, at most about 100 hours per year in years with sufficiently high tides. Typically, half of these inundations take place in (late) winter. Large ice cakes may be floated on top of supratidal marshes (just landward from tidal creeks) and remain stranded there, because flood currents continue to flow landwards for about 30 minutes after the time of high water. The sediment concentration of ice cakes may vary from 0 to 23% by weight and appears to consist mostly of silt-sized and finer material, but its variation within ice cakes as well as geographically is unknown and nearly impossible to predict. Research elsewhere suggests that coastal marsh accretion accelerated after colder winters and that amounts of ice-rafted debris equaled amounts of summer sediment accretion. Hence the hypothesis that winter ice contributes significantly to tidal marsh accretion.

Erosion of tidal marshes by winter ice seems to occur mostly in a lateral sense, i.e. on the banks of tidal creeks and channels. However, the creation of vertical ice walls along tidal creeks also has a stabilizing effect. This process too, has never been quantified.

As much as 60-85% of original tidal marshlands have been locked away behind dykes, a process that affected the storage capacity of the estuary as documented elsewhere. Tidal marshes are important primary organic matter producers, contributing significantly to the food chain. Questions regarding the mutual effects between winter ice and the construction of tidal turbines are not part of the Strategic Environmental Assessment (SEA), presently carried out under auspices of the Nova Scotia Government, thus suggesting that this is a solvable engineering issue. Thus, the extent to which winter ice contributes to the health of the few remaining salt marshes and the extent to which tidal turbines may interfere with ice formation, ice circulation and sediment budget of a fragile environment remains a risky unknown.

A Research Agenda for Fundy: results from the 2006 'Fundy Session' at Atlantic Geoscience Society

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During the 2006 AGS Colloquium, we convened a session on Sedimentation in the Greater Bay of Fundy. The aim of this session was to define a research agenda, an exercise that had not been carried out for a long time and which we deemed necessary because of: a) global change implications, b) renewed interest in tidal power generation, c) changing views on

coastal zone management practices. These were the most important topics of the agenda: (1) map the entire Bay floor using multibeam bathymetry, paying special attention to mussel reefs and large sand and gravel bedforms; (2) establish the timing of origin of the big sand waves on the bottom of the Bay; (3) establish a sediment budget, paying special attention to the different contributions of bedload, suspended load, organic and inorganic matter; (4) improve understanding of sea level rise over the last 10,000 years; (5) establish the proportions of organic and non-organic material in the sediment column; (6) establish a sediment monitoring system in the upper Bay prior to removing the Petitcodiac causeway; (7) quantify the role of winter ice as a source of sediment and in relation to marsh ecology; (8) quantify the effects of (increased) wave activity on exposed marsh cliffs; (9) compile detailed high-resolution LIDAR surveys of marshes and mudflats; (10) integrate modern and historical bathymetric data with historical aerial photography and HR satellite imagery; (11) expand monitoring of dredge spoil disposal sites, as at Saint John (NB), to elsewhere; (12) address bottom fishing and its effects on benthic communities and sediment erosion.

The 2008 session has been convened to document progress and revisit the agenda in the light of recent (political) developments.

Radial growth of trees from northeastern to southeastern Labrador

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Prior to the Mount Allison Dendrochronology (MAD Lab) sampling in the summer of 2007, little tree ring work was conducted in Labrador, with the most studies coming from the eastern coast and from one species. Given this, the information is still quite spotty, as the cost of transportation and limited tree availability has limited a systematic sampling across the landscape.

Over this backdrop, the MAD Lab initiated a more region-wide study breaking Labrador into three zones (east, west, and north). Within each zone a consistent grid was used that will link the entire region together, while at the same time highlight the major zones of homogenous tree cover currently found. This talk will illustrate some of the early results of areas in southeastern Labrador, while at the same time discuss some of the difficulties in sampling the more northern locations. Three species will be discussed (white spruce (*Picea glauca*), black spruce (*Picea mariana*) and balsam fir (*Abies balsamea*)). Preliminary results from chronologies of black spruce and balsam fir developed from the southeastern region will be compared to the other chronologies in adjacent areas in Labrador, highlighting some of the similarities and differences in growing conditions that are already being seen.

Climate change: An atmospheric perspective

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Climate change is currently dominated by anthropogenic global warming induced by the burning of fossil fuels. Natural causes of climate change will likely be only a minor contributor in the 21st century. The anthropogenic increase of atmospheric greenhouse gases such as carbon dioxide, methane and nitrous oxide is enhancing the downward long wave infrared radiation at the Earth's surface resulting in higher temperatures. Much of the total warming is a result of the positive feedback associated with increasing atmospheric water vapour, itself a very strong greenhouse gas, which accompanies the higher temperatures. Large uncertainties still exist in quantifying a number of other feedbacks such as clouds, ocean circulation, surface albedo and vegetation. As a result climate models used in the latest IPCC Fourth Assessment predict that a doubling of carbon dioxide equivalent will increase the equilibrium global averaged surface temperature in the range from 2.0 to 4.5 C with 3.0 C being most likely. Very significant regional climate change, including more frequent floods, droughts and heat waves, are predicted if atmospheric carbon dioxide continues to increase without strong mitigation efforts.

The search for life on Mars: the importance of Mars-like minerals on Earth to astrobiology

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In recent years, orbital and surface missions have provided a wealth of information on the Red Planet. In particular, the mineralogical composition of surface materials has helped to unravel the geological and climatic history of Mars. The ongoing accumulation of information and knowledge about Martian mineralogy, geochemical processes and climate history is helping to define search strategies for future missions that will specifically seek out traces of past life or evidence of existing life – two of the primary goals of astrobiology. This talk will give an overview of the importance of studying Mars-like minerals on Earth as an important step to addressing whether life ever existed on Mars.

Spectroscopic data from *Mars Global Surveyor* and *Mars Express*, as well as from the Mars Exploration Rovers show that *Ca-Mg-Fe-sulphates* are abundant and diverse at various locations. The fact that these sulphates almost exclusively require liquid water to form means they are of interest to astrobiologists. The presence of the ferric sulphate jarosite within sedimentary rocks at *Meridiani Planum* has received particular attention because this mineral only forms at relatively low pH in Earth systems. Therefore, its presence suggests that the aqueous solutions that deposited or altered these rocks were acidic. This could potentially have important implications for the development of life on Mars or for the preservation of biosignatures of early Martian life. However, jarosite has recently been discovered within carbonate sediments on Devon Island in the

Canadian High Arctic. This finding shows that jarosite can form in a well-buffered environment and likely only requires localized or transient acidic conditions in order to form.

Various Ca-Mg-Fe-phyllosilicates (or clay minerals) have also been identified in some of the oldest terranes exposed at the Martian surface. Their presence suggests an early active hydrologic system, and the formation of these abundant and widespread clays would have required the presence of persistent liquid water over extended periods of time, as phyllosilicates generally form from extended periods of water-rock interaction at near circum-neutral pH. These deposits may therefore represent some of the best places to search for past habitable environments and traces of relict life on Mars. Clays are known to bind and trap organic molecules. They may also be formed by microorganisms, in some case preserving physical traces of such processes. Their catalytic properties have also been implicated in prebiotic chemistry on Earth – and perhaps Mars. However, very little work has been done on biosignature formation and preservation in clay-rich systems. It is therefore imperative that the formation and preservation of microbial biosignatures in clay minerals is studied in more detailed using analog systems on Earth in anticipation of future Mars missions.

Newly-recognized lowstands of the Laurentian Great Lakes signal their sensitivity to changed climate

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Today the Great Lakes are collectively ranked as North America's largest freshwater reservoir. Their five basins support a total population of >33 million persons, and host well-developed activities and facilities for shipping, industry, power production, fishing, recreation, and municipalities. Their monthly mean levels have varied little more than ± 1 m during 150 years of instrumental measurement, and thus appear relatively stable. Together, the lakes contain 23,000 km³ of water, and their watersheds add about 1 % of this volume annually, derived from precipitation and runoff. Overflow from this positive water balance sustains major rivers and shipping canals between lakes, and discharges to the St. Lawrence River. In a similar way, geologists and paleo-hydrologists have always considered the paleo-Great Lakes to have been overflowing bodies of water since their formation during retreat of the last (Laurentide) ice sheet. This paradigm of continuous abundant water supply is shown to be false by recent findings of early Holocene lowstands, indicated by submerged tree stumps, beaches, and spillways, buried erosion surfaces, infilled river valleys, and a new analysis of differential glacio-isostatic uplift.

Comparison of the early Holocene lake level, based on the original elevations of all dated lake-level indicators, with the uplift history of possible outlets, revealed an episode of low water level tens of meters below outlets about 7,900 ¹⁴C (8,800 cal) BP, possibly a few centuries long. Lakes without outflow can only be explained by a dry climate in which water losses by evaporation exceeded water additions by precipitation and runoff.

The discovery that the Great Lakes entered a phase of negative water balance in a dry climate with low water levels below outlets, and hence without connecting rivers, signals the sensitivity of these lakes to climate change, and that significant reductions in lake level relative to current societal usage should be expected as climate in the Great Lakes Basin warms in future. Modeling and prediction of future levels requires confident knowledge of the sensitivity of the Great Lakes hydrology to climate change. An opportunity to add to this knowledge is possible by further research and quantification of this new phase of early Holocene climate and closed lakes.

Sources of magnetic and gravity anomalies on the Scotian Shelf southeast of Cape Breton Island, Nova Scotia, and onshore-offshore geological correlations using geophysical modeling

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The Scatarie Ridge Magnetic Anomalies (SRMA) form a prominent northeast-trending belt, 100 km long by 25 km wide, on the Scotian Shelf southeast of Cape Breton Island. The area is inferred to be part of the Mira terrane, a component of the Avalonia realm of the northern Appalachian orogen. The magnetic anomalies range from 300 nT to 600 nT with the centres reaching highs of 1000 nT. Associated with the magnetic anomalies are positive gravity anomalies that range from 10 to 30 mGal. This study used forward-modeling software to model magnetic and gravity data to investigate possible sources of the SRMA. The interpretations are constrained by physical property data measured in samples collected from onshore areas, and by multichannel seismic lines collected by PetroCanada and the Geological Survey of Canada Frontier Geoscience Project (Lithoprobe East). Using the second derivative magnetic map, the SRMA has been resolved into a linear anomaly trending east-northeast and two large magnetic aureoles located north of the central part of the SRMA. Forward potential field models indicate that the southern margin of the linear anomaly is the northern margin of the Orpheus Graben. A south-dipping fault separates rocks of the Meguma terrane to the south from rocks of the Avalon terrane to the north of the graben. The Meguma terrane is modeled as one unit with average density of 2750 kg/m³ and average magnetic susceptibility of 2×10^{-3} SI. The offshore Avalon terrane has been modeled as five geological units based on differences in magnetic susceptibility and density, in the range of 10×10^{-3} to 20×10^{-3} SI and 2600 to 2700 kg/m³, respectively. Upper crustal units beneath the Avalon terrane offshore have higher susceptibility and lower density than units beneath the onshore Mira terrane, suggesting that the offshore area is a different part of Avalonia, perhaps equivalent to the Antigonish Highlands or the eastern part of Avalon terrane in Newfoundland. The source of the large linear anomaly is interpreted to be a belt of mafic volcanic rocks at a depth of 6 - 15 km in the offshore Avalon terrane. The large magnetic aureoles have associated gravity anomalies indicating that they are caused

by granite plutons and magnetic rocks in the surrounding contact metamorphic aureoles. In the Gabarus Bay area, similar magnetic aureoles are associated with the Devonian Deep Cove granite and other intrusions. Two granitic bodies south of the Orpheus Graben in the Meguma terrane have densities and magnetic susceptibilities similar to Devonian plutons in the adjacent onshore part of the Meguma terrane.

Thermal structure and chemical composition of the Archean mantle and origin of mantle “plumes”: Insights from ca. 2.73 Ga komatiite and basalt, Nunavut, Canada

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Geochemical studies of komatiite- and basalt-dominated volcanic successions within late Archean supracrustal belts have the potential to yield important insights into the thermal structure and chemical composition of the early Earth's mantle, as well as the dynamics of mantle melting. The high eruption temperatures and degrees of melting that are required to explain the first-order geochemical features displayed by the vast majority of late Archean komatiite, namely their high-MgO contents and pronounced depletion in incompatible elements, have been used to argue that these magmas must have an origin related to mantle plumes. Unfortunately, the near universal acceptance of a mantle plume origin for komatiite is used as an argument (circular) for the existence of plumes, and geochemical observations are routinely interpreted in terms of the modern plume paradigm. The underlying assumptions of the paradigm are seldom questioned or why, if they exist, potential plumes in the modern mantle might be similar to those in the Archean. Currently, no consensus exists on the nature or very existence of modern or ancient mantle plumes and their relationship with respect to the ambient mantle, a situation that requires remediation. This study presents geochemical data from a unique and exceptionally well-preserved ca. 2.73 Ga volcanic succession dominated by large volumes of chemically diverse komatiite and basalt recently discovered in the Canadian Arctic. This succession constitutes the basal sequence to a vast network of co-genetic clastic-dominated supracrustal belts (~1400 km long and ~400 km wide) formed between ca. 2.73-2.69 Ga. Modeling the geochemical data with constraints from high- and low-pressure peridotite melting experiments has yielded the following conclusions: (1) high-MgO komatiite magmas were derived from thermally anomalous mantle, which was ~150 °C hotter than the ambient mantle; (2) the ambient ca. 2.7 Ga mantle was ~200 °C hotter than the modern mantle; (3) ambient and thermally anomalous mantle are the same composition and both are similar to the modern depleted upper mantle; (4) Archean mantle plumes are discrete “parcels” of thermally anomalous mantle; (5) primary magmas within the late Archean were komatiitic not basaltic; (6) plumes have an origin within the upper mantle; and (7) the source of thermal energy required to heat the upper mantle may ultimately have originated from the core.

Impacts of Climate Change to the Water Resources of Cape Breton Island, Nova Scotia

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Predicted changes in climatic conditions could alter the annual snow pack which accumulates in the Highlands and cause earlier timing of the spring freshet. If the warmer temperatures result in more rainfall and less snow accumulation, less snow would be available for the spring melt. This meltwater affects many aspects of the surface and ground water conditions later into the year. Mid to High latitude rivers have been modeled to respond to the expected increase in temperature due to climate change, in general, these trials have resulted in slightly lower average flow and earlier spring maximum flows. This modeling has been performed for major river systems and the implications would vary for smaller watersheds, also depending on the particular climatic changes that occur within each specific watershed area. Watersheds which are not snow dominated may not see much average annual change, however, the Highlands are dominated by a snowbelt region and could have significant alterations to the river systems in that area. Geological setting also appears to be an important consideration in this region, particularly due to its influence on baseflow recession.

Mineralogical investigations at Canadian Analogue Research Network (CARN) sites using a portable Raman spectrometer

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Presently, the search for life on Mars has focussed on minerals formed by chemical precipitation. Miniaturized Raman spectrometers have been proposed for future rover missions to Mars, such as the European Space Agency (ESA)'s ExoMars rover to be launched in 2013. A 10-week internship was dedicated to assisting a Canadian Space Agency project investigating the use of Raman spectroscopy on geological samples: carbonate and iron-oxides/iron-sulphate precipitates, for its potential

applications on a Mars rover or lander. The off-the-shelf portable Raman spectrometer was tested at analogue sites in the central Yukon Territory and from the Houghton Impact Crater, Devon Island, Canada.

The Raman spectrometer utilizes a 120 mW laser with a wavelength of 785 nm. The instrument can detect Raman spectrum within the range of 100-2000 cm^{-1} at resolution of detection of 8 cm^{-1} . Preliminary assessments revealed that the instrument was able to conclusively identify carbonate (calcite and dolomite) and sulphate (gypsum) minerals. However, spectra from carbonate samples that had a high percentage of organic material (~5%) proved to be inconclusive: fluorescence from this organic material is thought to have caused interference with the Raman spectra.

With relatively minor upgrades, including a small, rugged computer, attachment stage, and fitted cover, the portable Raman spectrometer system used in this study could be functional in a field environment. However, to be more effective, this system would also benefit from a wider selection of standards in the library database and more effective matching criteria.

A Holocene sedimentary record of the Labrador Current

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The climate of the Atlantic Provinces is influenced by the Gulf Stream and Labrador Current. As temperature rises in response to increased CO_2 output, the increased melting from Greenland may cause a strengthening of the Labrador Current, which could result in regional cooling.

In this study, one marine sediment core from Karlsefni Trough on the Labrador Shelf is analyzed for its Holocene sedimentological record of the Labrador Current in order to determine how the strength of the current has varied in the Holocene. This core was analyzed using the Geological Survey of Canada Atlantic facilities at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia.

Grain size data was obtained from Coulter Laser analyses and percent CaCO_3 was obtained using a LECO carbon determinator. Using the signature of ice-rafted detritus (IRD) and the percent CaCO_3 , the sediment supply to the area was inferred. An age model of the core was determined using carbon-14 dating of mollusk shells and foraminifera.

The Karlsefni Trough core was found to be older than 8.9 ka. Based on the high percent CaCO_3 , the source of the sediment in the cores before 6.3 ka was inferred to be Canadian Arctic proglacial sediment. After 6.3 ka the CaCO_3 drops off and is inferred to be only terrigenous sediment from ice-rafting and reworking of bank sediment. Using the carbon-14 dates, IRD, percent sand, color, and percent CaCO_3 the core was interpreted to contain marker beds for both the Lake Agassiz and Foxe Basin Deglaciation events.

The sortable-silt proxy for current strength in the Coulter Laser grain-size data shows a trend from almost unsorted at the base of the core to very well sorted around 7.8 ka with a slight dip around 6.9 ka and a return to maximum strength in the upper part of the core, estimated at 4.4 ka, before gradually declining to the present.

A strong sorting signal can be caused either by reworking of the adjacent bank sediment or a very strong Labrador Current. If there were a large sediment input from the bank, the IRD would be diluted. This is not the case, since IRD increases from around 5.4 ka to the present time. Therefore, the sortable-silt proxy appears to represent variations in the strength of the Labrador Current. Further work is needed to identify what past changes in climate and particularly precipitation on land correlates with increased late Holocene strength of the Labrador Current. Such an understanding may help predict future changes in the Labrador Current as a result of global warming, which could have economic, social and environmental impacts on the Atlantic Provinces.

In-situ LA-MC-ICPMS Sm-Nd dating using REE-enriched accessory minerals

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Whereas Sm-Nd isochron ages have conventionally been obtained using combinations of dissolved and purified whole rock and major-mineral aliquots analyzed by TIMS, the recent development of precise and accurate LA-MC-ICPMS Sm-Nd analyses of REE-enriched accessory minerals provides a potentially rapid method to date high-temperature magmatic and metamorphic crystallization events. Monazite, allanite, titanite, and apatite, which together comprise the bulk of the LREE budget of most crustal rocks, have all been successfully analyzed for Sm-Nd using LA-MC-ICPMS at spatial resolutions ranging from 16 μm (monazite) to 150 μm (apatite). For these laser crater sizes, precision better than 50 ppm (2σ) can typically be achieved on $^{143}\text{Nd}/^{144}\text{Nd}$. This technique was originally developed to combine in-situ SHRIMP U-Pb ages and Sm-Nd systematics to investigate isotopic inheritance at the grain scale. However, the technique can also be used to obtain relatively precise Sm-Nd isochron ages independent of external calibrations, matrix corrections, or time-consuming isotope dilution. By analyzing a range of (presumed) cogenetic LREE-enriched accessory minerals from the same rock to obtain a range of Sm/Nd, a sufficient number of data points can be collected in a single analytical session to define a statistically robust isochron age. In the example presented here, a fresh granite sampled from the Morila Mine, Mali, was dated at 2093 ± 6 Ma (1σ) based on an upper intercept of near-concordant SHRIMP U-Pb data for oscillatory zoned zircon. Allanite and apatite separated from the same rock were analyzed for Sm-Nd using LA-MC-ICPMS. The range of $^{147}\text{Sm}/^{144}\text{Nd}$ both between allanite (~0.07) and apatite (up to 0.16) and within each group of analyses provides a sufficient spread of Sm/Nd to calculate a reasonably precise Sm-Nd isochron age of 2097 ± 36 Ma (1σ). This demonstrated precision and accuracy combined with the ability to target

accessory minerals in thin section (unknowns and standards can be mounted separately), can, therefore, be exploited as a geochronological and Sm-Nd isotope tracer tool to help guide interpretations for the origin and evolution of Proterozoic and older rocks.

The Tail of the Bank Mud: a deposit originating from Agassiz –driven outburst floods?

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Along the Labrador and northeastern Newfoundland continental margins we recognize distinct Holocene-aged sediment layers rich in detrital carbonate (DC) that likely originated through entrained glacial sediment eroded from Paleozoic limestone and dolomite bedrock flooring Hudson Bay and Strait, and transported in plumes and ice rafts by catastrophic discharges from glacial lakes in both the inner and outer branches of the Labrador Current. Radiocarbon dating shows that two DC layers on the northern Northeast Newfoundland Shelf correlate to glacial Lake Agassiz outbursts and retreat of the Noble Inlet ice advance, respectively. Foraminiferal faunas indicate the layers are associated with reduced-salinity waters. DC layers in a recently re-examined core from southern NENS suggest that outburst floodwaters likely continued traveling southward in the Labrador Current toward Grand Bank, where on the southern margin of the Bank an enigmatic deposit of sandy mud has long been known. The Tail of the Bank Mud consists of silty and clayey sand, the deposit is up to 30 km wide, and extends 200 km along the edge in present-day water depths of 55 to 120 m. The Mud rests unconformably on an erosional surface formed by the last marine transgression, which was submerged here after 10 ka. Recognition of outburst floods issuing from Hudson Strait into the Labrador Current raises a possibility that suspended plumes and ice-rafted sediment carried by these floods may have been a source for the Mud, and that mixing of early Holocene marine and floodwater could explain its known lower-salinity fauna. This is supported by new analysis of two cores that reveals two DC layers with the same foraminiferal fauna as found in DC layers farther north that are correlated to the Holocene lake outburst floods. The recognition of Holocene-aged DC layers and oxygen isotope evidence in Scotian Slope cores also indicates that outburst reduced-salinity waters had been transported south of Grand Bank at this time.

We hypothesize that icebergs and outburst waters flowed over and around Grand Bank and were transported over the shelf edge into the northern zone of the Gulf Stream. Warmer water temperatures and decreased current velocity in the deeper water facilitated deposition on the Tail of the Bank. Some of the reduced-salinity waters may have been carried by the Gulf Stream and North Atlantic Drift to the Nordic Seas, where they could have decreased thermohaline circulation, and contributed to a cold event.

Geotourism in Saint John, New Brunswick

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Geotourism definitions range from the global view of “Tourism that sustains or enhances the geographical character of a place—its environment, heritage, aesthetics, culture, and the well-being of its residents” to a more focused perspective where “Geotourism is tourism surrounding geological attractions and destinations”. Geotourism, based on the observation and understanding of geology, is a growing part of the tourism market. While geotourism is not new, the development of the European Geoparks Network and the UNESCO Geopark program are providing models for engaging the public in the appreciation of geology that link sustainable economic develop with the preservation and interpretation of geology. We think of geotourism destinations as sites with dramatic landscapes and obvious interpretive and geological impact, but there are other opportunities to incorporate less obvious geological stories into the tourism and public realm. With support from the Community–University Research Alliances (CURA-SSHRC) we have been exploring geotourism opportunities in the Saint John region. Interest has come in part from the tourism industry, seeking to enhance a product that includes exploitation of cultural and natural attractions in a market that strives to provide unique experiences for visitors. In Saint John, boat tours of the Reversing Falls have added the geological story of the gorge to their traditional interpretation of the tides. Kayak tour guides are seeking information about geology to enhance their stories of the natural and cultural landscape. Trail designers are looking for information to develop interpretive signs along walkways. Tour operators working the cruise ship market have considered tours of geological sites for ship passengers. Our strategy for enhancing geotourism includes research and development of human interest stories. Viewing the ‘study of geology’ as important as the science reminds us that geoscience is part of society. This region has promoted its shipbuilding heritage and stories of owners, builders and sailors. The same cannot be said of its geoscience heritage and the people who explored and interpreted the rocks. Nevertheless geoheritage stories captivate the public. The Pennsylvanian geology of west Saint John has puzzled geologists for 150 years. Synthesizing the science into a 30 minute tour can be difficult. But who is not intrigued by the visit of a colourful character like Marie Stopes (both a paleobotanist and a pioneer in the sexual revolution) to Saint John in 1911, and her efforts to reconcile a bitter debate about the age of the rocks at “Fern Ledges”.

Development of a background soil chemistry/toxicology database for the Atlantic Region and the North American Soil Geochemical Landscapes Project (NASGLP)

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The need for baseline soil geochemical data to effectively assess and manage natural resources and the risk of environmental hazards is well recognized. One particular application of such data is to compliment the ecological and human health risk assessment processes. While other jurisdictions have established background soil data, at present, there is limited data on the background soil chemistry for the Atlantic Region. Environment Canada-Atlantic (EC-Atlantic), in partnership with other stakeholders, has undertaken the development of a background soil conditions for the region. In addition to standard chemical analyses, the sampling protocols also include subjecting a portion of the soils to several soil toxicity tests which provides a biological aspect to the chemical data interpretation. Samples have been collected throughout the Atlantic Region over the past 4 years and the resulting data is being collated in a GIS-based database. A key purpose of this research is provide risk assessors with additional data in which to incorporate into their risk calculations, further strengthening the scientific validity of the risk assessment process.

The North American Soil Geochemical Landscapes Project (NASGLP) is a tri-national initiative between US, Canada and Mexico designed to understand the amount and origin of variation in soil geochemistry and to establish a consistent methodology for determining these characteristics. For Canada, this project is being lead by Natural Resources Canada with in-kind support being provided by EC-Atlantic, Health Canada, Agriculture Canada and several provincial departments of natural resources. EC-Atlantic has partnered with NASGLP in order to exchange protocols and data, allow comparisons between the sampling protocols at each site (discrete sample vs. composite samples, horizon-based sampling vs. integrated 0-30 cm sampling, etc.) and optimize sampling efforts between the two projects. NASGLP sampling occurred in between June and September 2007 resulting in the collection of approximately 175 samples from Nova Scotia and New Brunswick. These samples are to be analyzed for metals, polycyclic aromatic hydrocarbons (PAHs), total organic carbon, pH, and grain size. In addition, bulk soil samples were collected at 30 sites for the purposes of toxicological testing. Chemical and toxicological results are pending.

Did Laurentide Ice Sheet Floodwater Change the History of European Civilization?

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In a recent (November 2007) paper, it was reported that a 1.4 m increase in sea level rise accompanied the collapse of the Laurentide Ice Sheet, and the resulting discharge of floodwater from 8.4-8.2 cal ka BP drowned a subaerially exposed Black Sea shelf with seawater. The consequence of this hypothetical catastrophic flooding was that early Neolithic farmers had to flee from the region to higher ground in Europe and Russia, thus ending cultural development in the Pontic region for several millennia. In contrast, our paleoenvironmental data collected from sediment cores on the SW Black Sea Shelf and the Marmara Sea show that the Black Sea was already connected to the World's Oceans by 9.5 cal ka BP, and central shelf was flooded by brackish water to a depth of ca. 20 m by 8.6 cal ka BP or earlier. Our data show a slow two-step reconnection of the Black and Mediterranean seas in the early Holocene, at which time the climate was relatively warm and wet, not cold and dry as required for drawdown and isolation of a Black Sea lake. Our palynological data also show that there is no evidence for either a catastrophic flood around 8.4-8.2 cal ka BP, or for sustained agriculture near the Black Sea before the Bronze Age, ca. 6 cal Ka BP. Furthermore, our paleoenvironmental reconstruction is consistent with the available archaeological evidence showing a steady early Holocene migration of agricultural societies into the Mediterranean and Europe westwards from centers in the Middle East.

Geochemistry and Sm-Nd isotopic signature of the 0.76 Ga Burin Group: a compositional equivalent of the basement for late Neoproterozoic Avalonian magmatism?

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The ca. 760 Ma Burin Group occurs in a 60 km long northeasterly-trending belt on the Burin Peninsula of southeastern Newfoundland and consists of low grade massive and pillowed basalts, abundant dykes and sills, with minor mafic pyroclastic

rocks and limestone. The Burin Group preserves the oldest known magmatic event in the Avalon terrane, but its tectonic evolution and its relationship to the voluminous 635-570 Ma arc-related magmatism that typifies Avalonia is uncertain. Geochemical analyses confirm that the basalts are predominantly low-K tholeiites. They are characterized by high LIL/HFS, and display depletion to slight enrichment in LREE. Sm-Nd isotopic data reveal that most basalts have juvenile compositions, with ϵNd values similar to contemporaneous depleted mantle, indicating that high LIL/HFS was probably due to coeval subduction which contaminated the mantle source. Other basalts have lower ϵNd values, and the negative correlation of ϵNd with La/Sm, together with a positive correlation of ϵNd with $^{147}\text{Sm}/^{144}\text{Nd}$ suggest that their isotopic signatures have been modified by a Mesoproterozoic or older crust or sub-continental lithospheric mantle into which Burin Group mafic volcanics were emplaced. The isotopic signature of the Burin mafic rocks is similar to that inferred for the source of the main phase of Avalonian magmatism. These data, together with paleocontinental reconstructions for ca. 760 Ma, suggest that the Burin Group is a local representative of an ensimatic arcs within the peri-Rodinian ocean, possibly as a far-field response to the breakup of Rodinia. Vestiges of these arcs were accreted to the northern Gondwanan margin at about 650 Ma, and then recycled by subduction beneath that margin during the main ca. 635-570 Ma Avalonian event. Although its low metamorphic grade precludes it being the basement from which Avalonian magmas were extracted, the Burin Group may be representative of the geochemical and isotopic composition of that basement.

Geological mapping in Northwestern Bhutan using ASTER remote sensing data

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A klippe of low-grade metasediments is exposed in northwestern Bhutan, the base of which forms the erosional remnant of the southern-most extent of the South Tibetan Detachment (STD) system. This detachment is an orogen-wide normal-sense shear zone that forms the upper boundary of the Greater Himalayan Sequence (GHS), the exposed metamorphic core of the Himalaya. Field mapping in this region of Bhutan is hindered by many factors such as access, terrain, expense and climate. Thus, many geological boundaries are inadequately mapped and constrained. Due to high elevation, lack of vegetation and good exposure this area is well-suited for mapping using remote sensing data. Here we examine the use of ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) remote sensing data for geological mapping of a critical area of the Bhutan Himalaya. The main lithologies mapped using ASTER are: gneiss, leucogranite, metapelite, metacarbonate and shale. The first two belong to the footwall block (i.e. GHS) and the other three units to the hanging wall block of the STD. A structural analysis of the field data from the area is used to help constrain remote sensing mapping and construct geological cross-sections of the study area. This study has improved the geological map of a largely inaccessible, yet geologically significant region of the Himalaya and highlights the effectiveness of using remote sensing data as a geological mapping tool.

Hydrocarbon potential of the eastern Shelburne sub-basin and surrounding areas from petroleum systems modelling constrained by well log information, seismic images, and analogue models.

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Recent petroleum exploration on the Scotian margin has yielded poor results as new wells drilled into the shallow-water shelf and along the deep-water continental slope struck no economic hydrocarbon deposits. This lack of recent exploration success shows that a better understanding of the Scotian margin's geological complexity and structural evolution is required for future successful exploration. In an attempt to broaden our knowledge of the Scotian margin, I have compared analogue modelling results with seismic data from the eastern Shelburne sub-basin and surrounding regions, and have created a petroleum systems model of the area using PetroMod software. The goal of this project was two fold: (1) Interpret and correlate available seismic data with available well data from the targeted area for petroleum systems modelling, as well as for comparison with existing analogue models; (2) Create a petroleum systems model constraining possible hydrocarbon reservoirs, also to be used in determining regions for future heat flow measurements in the Scotian Basin.

Three 2D Seismic lines from the GXT NovaSPAN survey and one 2D Lithoprobe line were interpreted, depicting stratigraphic boundaries and outlines of all salt structures present. A 3D analogue model with a symmetric rift graben basement structure and thick salt fill (~2 km when scaled) representing a possible Late Triassic configuration in the Scotian Basin was structurally analyzed and retrodeformed. Salt structures identified in the analogue model were compared to those in the seismic images. Structural restorations of the analogue model through time constrained the evolution of the salt deformation structures and provided insight on the formation mechanism of salt structures within the Scotian Basin. The simplified analogue model setup of the Scotian Basin developed many salt structures similar to those seen in seismic images. The 2D seismic lines all intersect forming a four sided grid, and the interpretations of these lines were used to create 3D surfaces as the initial constraint for petroleum systems modeling. The retrodeformation of the analogue model was used to provide constraints for the evolution of salt structures in the petroleum systems model, and well data from the region was used to provide stratigraphic and sedimentological constraints in the model. The model is used to interpret the hydrocarbon potential of the region, and to demonstrate in 3D the locations and evolution of salt diapirs. The model also produces surface heat flow estimates and is used to interpret the affects of salt diapirs on heat flow. The model will ultimately be used in order to define potential regions for future heat flow measurements within the Scotian Basin.

Dendrochronological Analysis of Four Conifers in Western Labrador

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To date, little dendrochronological research has been conducted in western Labrador and therefore limited analysis of past tree growth patterns exists for this area. A study was undertaken to address this gap in knowledge this past summer. This paper will look at some of the first results coming from an inter-species comparison of the radial growth rates of four species from this region.

Balsam fir (*Abies balsamea* (L.) Mill.), white spruce (*Picea glauca*), black spruce (*Picea mariana*) and tamarack larch (*Larix laricina*) are this region's dominant coniferous species, and all four were sampled at sites along a north-south latitudinal transect (55N 62W to 52N 62W). Each chronology was analyzed using standard dendrochronological procedures, with cross-dating results indicating that there is a link between all sites and between species. Each species seems to be acting in a similar nature across the spatial gradient and so we suggest that the dominant factor that links these growing environments on a regional scale across the grid is climate.

Earth science outreach in Canada: Cottage industry or national program?

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Science outreach in Canada has gone through many phases. In the late 19th Century, science was of great interest to educated people. However in the early 20th century science became more exclusive and public accessibility declined. By the mid 20th century there was peer sneer in the science community for those who undertook outreach activities. This attitude has been dissipating slowly since the 1970s and now most earth science organizations support outreach, but do not fund it well. During the modern period of re-development of earth science outreach, programs have grown through locally based organizations and individuals. The programs are analogous to cottage industries, which are characterized by small scale production of high quality, hand-made products with limited production and only local distribution. The level of earth science outreach has increased dramatically over the past 35 years. Thousands of teachers have taken EdGEO workshops. Many have perused geoscape posters and brochures, and watched television programs to learn more about earth sciences. Many have visited museums, science centres, parks and geoheritage sites or attended public lectures to learn about earth science. Increasingly, we develop projects that involve the whole community from scientific, cultural and economic viewpoints; a wonderful example is the Community Mapping Program conducted in N.W.T. But the fact remains that few Canadians understand the significance of earth science for their everyday lives. They fail to understand where all their stuff comes from and they remain largely unaware of Earth processes that affect them. Based mainly on volunteer effort, the Canadian geoscience community is trying to reverse this situation. Most programs originate locally and are completed at low cost. This local approach means that many excellent products are not widely available because of a lack of national distribution. Experience is not well shared and efforts are not coordinated nationally. There is no funded, active national inventory of resources for Earth science outreach. Is geoscience outreach to remain a cottage industry forever or can it aspire to operating nationally? These are questions we must ask of the main institutions: geological surveys, societies, universities, science centres and resource industries. People need to know about the Earth to be responsible citizens of the planet, yet earth science is barely taught in schools. If our profession is to rejuvenate and gain influence in society, we have to attract new people. Therefore, young people have to be aware of it. These requirements argue for a national approach to earth science outreach. The International Year of Planet Earth affords an opportunity to leave a national legacy of earth science outreach and we need to embrace it strongly and make it work.

Distribution, Form, and Origin of Precious Metals related to the Boomerang and Domino Volcanogenic Massive Sulfide deposits, Tulks Belt, Central Newfoundland

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The Boomerang and Domino volcanogenic massive sulfide (VMS) deposits are hosted within felsic pyroclastic rocks of the Victoria Lake Supergroup located in central Newfoundland's Tulks Belt. The Tulks Belt is a Late Cambrian to Middle Ordovician bimodal volcanic arc and back-arc basin assemblage. Numerous other prospective VMS deposits occur in this belt, e.g., Tulks Hill, Tulks East, Bobby's Pond, Daniel's Pond, Jack's Pond, and Curve Pond. Indicated mineral resources for the Boomerang deposit were recently calculated to be 1.36 million tonnes grading 7.09% Zn, 3.00% Pb, 0.51% Cu, 110.4 g/t Ag, and 1.66 g/t Au at a 1% Zn cut-off grade with similar inferred grades calculated for the nearby Domino deposit, and other deposits with this belt. The Boomerang and Domino massive sulfides commonly occur as lenses hosted within fine to sandy ash tuffs of dacitic composition with rare lapilli clasts and intervals of graphitic argillite in the hangingwall. In hand sample, sulfide banding is evident as thin layers rich in sphalerite ranging from nearly massive units to laminated fine-grained sphalerite and galena in association with pyrite, locally with irregular-shaped chalcopyrite forming pressure shadows, up to 5cm in size. In general, the sulfide assemblage consists of intergrown equigranular, subhedral sphalerite, galena, and pyrite with lesser amounts of chalcopyrite, tetrahedrite, and arsenopyrite. Pyrite constitutes over 40% of the total sulfide content at the Boomerang and Domino deposit as primary fine grained, euhedral porphyroblasts within the sulfide assemblage, but is also brecciated to form porphyroclasts. Generally, coarse-grained pyrite and arsenopyrite are intergrown, reflecting recrystallization

as a result of regional deformation. Tetrahedrite commonly occurs as interlocking grains, inclusions, and along grain boundaries of the other sulfides. EPMA reveals Ag as a solid solution component within tetrahedrite, with minimal Ag within galena.

Multi-element ICP-ES analysis of precious metal-enriched massive sulfides ($n = 156$) of the Boomerang deposit show positive Spearman Rank correlations between Au and Ag (respectively) with As ($r = 0.91$ and $r = 0.81$), Cd ($r = 0.53$ and $r = 0.73$), Cu ($r = 0.66$ and $r = 0.82$), Fe ($r = 0.57$ and $r = 0.45$), Hg ($r = 0.70$ and $r = 0.73$), Pb ($r = 0.79$ and $r = 0.96$), Sb ($r = 0.84$ and $r = 0.84$), and Zn ($r = 0.59$ and $r = 0.79$); Au and Ag are strongly correlated ($r = 0.86$). These precious metal and whole-rock element associations reflect cryptic mineralogic relationships throughout this deposit, i.e., Au is associated with arsenian phases and Ag is associated with tetrahedrite- and galena-rich assemblages.

Laser ablation ICP-MS results from selected samples ($n = 8$) reveal elemental abundance variations from core to rim, complimenting earlier EPMA results. Arsenopyrite rims are enriched in precious metals, averaging 228 ppm Au and 25 ppm Ag with Co richer cores. Precious metal enrichment is evident in the cores of pyrite porphyroclasts, averaging 13 ppm Au and 382 ppm Ag with Co, Ni, and Hg concentrated in the rims.

Preliminary investigation of a major high-strain zone in the Caledonian Highlands, southern New Brunswick

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The Caledonian Highlands consist mainly of volcanic, sedimentary, and plutonic rocks formed in a continental margin magmatic arc complex in combination with later extensional tectonic events over a span of at least 70 million years in the late Neoproterozoic. The southern and eastern parts of the highlands are dominated by the Broad River Group, an assemblage of ca. 620 Ma rocks, including intermediate and felsic tuff, chloritic phyllite, and arkosic sandstone and conglomerate. Plutonic rocks of inferred ca. 620 Ma age occur in spatial association with the Broad River Group, and show a wide range in composition from gabbro and diorite to tonalite, granodiorite, and granite. The ca. 560–550 Ma Coldbrook Group forms most of the western part of the highlands, but also extends into the eastern part, where it is inferred to originally have had an unconformable relationship with the underlying Broad River Group. Typical Coldbrook Group rocks include intermediate to felsic lapilli tuff, dacitic to rhyolitic flows and plugs, laminated tuffaceous siltstone, amygdaloidal basalt flows, and coarse clastic sedimentary rocks. Circa 560–550 Ma plutons are widespread throughout the central and western parts of the Caledonian Highlands intruded into the lower units of the Coldbrook Group. Most consist of syenogranite with less abundant diorite and gabbro.

A major high-strain zone up to 5 km in width can be traced for at least 70 km diagonally across the highlands from at least the Big Salmon River area in the southwest to the Caledonia Mountain area in the northeast. In this zone, both the Broad River Group and associated plutons and the Coldbrook Group contain similar structural elements, related to a largely shared deformation history. Some of this history is apparent also in the 560–550 Ma plutonic rocks. A pervasive foliation (S_1) lies parallel to bedding (S_0), and although evidently composite (S_{0-1}) in the Broad River Group, this fabric is very heterogeneous in the younger Coldbrook Group, where low strain enclaves are widespread.

No folds have been seen of an F_1 generation, and no reversals of facing or vergence are apparent. A mineral lineation (L_{1m}) is locally prominent. The plutonic rocks have early fabrics, including a foliation (S_1) producing augen-gneiss with a prominent L-tectonite (L_{1m}). S_1 also includes a schistosity associated with the growth of white mica and breakdown of feldspar. Geometry suggests that S_1 in the granites is related to S_{0-1} in the supracrustal rocks, and L_{1m} in both units shares a common orientation. S_1 and S_{0-1} are crenulated by a strong second cleavage (S_2) axial planar to folds (F_2), the large-scale expression of which is an asymmetric synform containing a belt of Coldbrook Group rocks lying between Stuart Mountain and Point Wolfe River. Kinematic indicators suggest an overall top-to-the-southeast motion along thrusts that stack units of Broad River Group, Coldbrook Group, and plutonic rocks. Fabric development in the plutonic rocks implies a history of exhumation beginning under hot, anhydrous conditions, followed by hydration during retrogression as plutonic rocks were tectonically emplaced into this crustal stack. The youngest deformation features are brittle fractures filled with pseudotachylite. The age of these tectonic events is not yet well constrained, but could be as young as Carboniferous.

The Maritime Soil Project: a New Brunswick perspective

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The North American Soil Geochemical Landscape Project (NASGLP) was born out of the need for geochemical background data for health and environmental reasons and was initiated by the geological surveys of Canada, the USA, and Mexico. The New Brunswick and Nova Scotia Geological Surveys, together with Environment Canada Atlantic (ECA), proposed to make the Maritimes a showcase of the NASGLP with sampling to be started and completed in 2007. The Tri-National survey will be linked to the National Forest Inventory (a Natural Resources Canada initiative). The final database will

be accessible via the National Land and Water Information Service which is presently managed by Agriculture and Agri-food Canada (AAFC).

In an effort to ensure quality control and consistency in field methodologies, a field training session was organized in the Fredericton area in early June. Staff from AAFC, the United States Geological Survey, NBDNR, the Geological Survey of Canada (GSC), and ECA participated; the first Maritime Soil Project (MSP) sites were sampled. In total, 116 sites were sampled in New Brunswick; at each site, 19 samples were collected for 7 different agencies (including Health Canada, Environment Canada, GSC, NRCanForestry, ECAtlantic, USDHS, and NBDNR's Geological Surveys Branch). Analytical results are pending and will be tied in to existing databases. To facilitate this, an additional (till) sample was collected at each site. The soil types in New Brunswick are mainly podzols (100 out of 116 sites) with a lesser amount of luvisols (4) and brunisols (6), and locally gleysols (6). Although most soils were developed in till, a few were formed in other parent materials such as (glacio-)fluvial, glacio-lacustrine, and colluvium.

Health Canada's Radiation Protection Bureau requested that a soil Radon survey be included in the project and the GSC supported this request with a ground radiometric and soil permeability survey as well as on-the-job training. It was found that most areas of New Brunswick show moderate to high risk potential (by EPA and Health Canada standards) for radon. A local follow-up study in the Fredericton area showed that outdoor and indoor radon measurements do not correlate well. This study and a similar study in the Ottawa area indicate that indoor radon risk is more directly related to type and age of the dwelling.

Also, composite samples were collected from all sites for analysis of eco-toxicological compounds at Environment Canada's Moncton laboratory. The resulting database will testify to some of the visionary work during the initial stages of the project. Further evaluation of field procedures, "add-on" modules that were relatively simple to incorporate in a Maritime context, and archived sample material for future use, form part of the heritage of the MSP.

Preliminary results from multibeam bathymetry and LiDAR surveys in 2007 of the Bay of Fundy, Canada

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In 2006, the Geological Survey of Canada (GSC), in conjunction with Canadian Hydrographic Service (CHS) and several universities, commenced a three year program to map the Bay of Fundy on the east coast of Canada. The Bay of Fundy has the largest recorded tides in the world, with a maximum range of about 17 metres at the head of the bay. Tidal current velocities that exceed 4.5 m/s in restricted narrow passages at various points in the bay could be harnessed for electrical power generation. To date about 10,000 km² of multibeam bathymetry have been collected in the bay. Sub-bottom profiler data were collected simultaneously to provide information on the character and thickness of the sediments on the seafloor. Additional bathymetry and sub-bottom profiler data will be collected in 2008. CHS will use the data for improved navigation charts and GSC will integrate information from geophysical surveys, seafloor samples, photographs and video transects to produce surficial geology and benthic habitat maps. The resulting 1:50,000 scale maps will be released as part of a new Canadian national marine map series. Current meter and suspended sediment sensor data and time lapse photographs will be used to provide information on seafloor properties, nearbed hydrodynamics and sediment transport processes. These data, in conjunction with the improved bathymetry data, will be used to assess the accuracy of tide and current prediction models. The broad intertidal zone in the Bay of Fundy presents a challenge to collection of marine geophysical and bathymetry data. Traditionally, this area has not been surveyed due to the significant time requirements and inherent danger involved in operating vessels in coastal areas that dry between tides. However, these large drying areas were surveyed using airborne terrestrial laser (LiDAR), providing an opportunity to generate a continuous map of the marine, intertidal and terrestrial areas. The data were collected during an extreme low tide to provide detailed elevation measurements of the inter-tidal areas. Multibeam bathymetry data will be collected during high tides to provide a seamless digital elevation model across the intertidal zone. The presentation will focus on the status of the project after the first two years of data collection, challenges and future plans of the project as well as a summary of the most recent data collection and interpretation from the project.

Background concentrations of arsenic and mercury in soils from the Montague and Goldenville gold districts, Nova Scotia

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Recent studies of 15 historical gold districts in Nova Scotia have identified several areas where exposure to mine wastes may represent a potential risk to human health. Arsenopyrite (FeAsS) occurs naturally in the ore and surrounding bedrock in these gold deposits, and was concentrated in the tailings during historical milling operations. The concentration of arsenic (As) in tailings at these sites is generally two to four orders of magnitude higher than the 12 mg/kg Canadian Soil Quality Guideline for As in residential and parkland soils. Two sites, Montague and Goldenville, are of particular concern, as the tailings are located close to residential properties and are occasionally used for racing off-road vehicles. Environmental Site Assessments are ongoing at both of these sites to clarify the spatial extent of mine tailings, and to investigate the fate of windblown tailings

dusts. Delineation of the area impacted by tailings requires an understanding of the naturally occurring concentrations of As and mercury (Hg) in soils overlying the variably mineralized bedrock within these gold districts. In 2007, Natural Resources Canada collected samples of the top 0-5 cm of surface soil (the Public Health layer) from 46 sites near Montague, and 39 sites near Goldenville. Samples of individual soil horizons (H, Ae, B, and C) were also collected from 10 sites in Montague, and 6 sites in Goldenville, to evaluate the vertical distribution of elements in the soil profile. All samples were air dried, sieved to various grain size fractions (<2 mm, <150 µm, <63 µm), and digested and analyzed for metal(loids) and organic carbon using protocols commonly employed during environmental assessments (e.g. EPA Method 3050B). Preliminary results from these surveys show that the concentrations of As and Hg in all soil horizons are generally higher down-ice (south) of the ore zones in both districts, reflecting glacial erosion and transport of mineralized bedrock containing arsenopyrite and other sulfides. Analysis of the top 0-5 cm of soils shows the following ranges in As and Hg concentrations (<2 mm, HNO₃-H₂O₂ digestion): Montague: As, 2-273 mg/kg (median 40 mg/kg); Hg, 72-490 µg/kg (median 164 µg/kg); Goldenville: As, 2-140 mg/kg (median 13 mg/kg); Hg, 60-312 µg/kg (median 123 µg/kg). In general, the concentrations of As are highest in the B and C horizon soils, whereas Hg concentrations are highest in the organic-rich humus (H) layer. Data for As and Hg in soils from Montague are in close agreement with results from previous soil surveys in 9 gold districts conducted by the Nova Scotia Dept. of Natural Resources in 2003-2005. However, the concentrations of both As and Hg are significantly lower in most soil horizons at Goldenville. Results from this study will be used by the Nova Scotia Historic Gold Mines Advisory Committee to assess the distribution of tailings at these sites, and to help guide risk-management decisions.

Expanding on Radial Growth Forecasting: Future Responses of Tree Species of the Acadian Forest to Climate Change

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As the climate begins to warm optimal conditions for various tree species will undergo geographical shifts. Over the long-term, the ranges of particular species will respond through slow migrations to the new optimal climatic zones. In the short-term, trees currently or soon to be rooted will be forced to endure the altered climatic regimes in their current positions. The features of the future climate that will drive or limit their radial growth rates will, in some cases, cause deviations from past environments. Some species will lose their competitive advantage while others may gain the ability to become dominant.

This ongoing project is in the process of forecasting radial growth response to future climates using past tree growth data, past weather data and projected coupled global climate model data. The radial growth models being produced will provide a means to identify the most at risk species and the most potentially robust tree types. Outcomes will help determine new sustainability goals in both conservation and resource use areas.

Results of the projected species forecasts indicate that white pine will not be greatly affected by increases in temperature. Eastern hemlock should increase its growth rate by up to 60% by the year 2100 as the growing season lengthens. Eastern white cedar reacts poorly to hotter drier July conditions and it should decrease its growth rate by as much as 75% by the year 2100. Meanwhile red and black spruces appear to hold remain stable or increase their growth rates slightly. What is not known exactly is if the potential for an increase in insect activity will limit their success.

Anthropogenic climate change: a geological perspective

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Earth scientists are well known as a group of scientific stakeholders unusually sceptical of the importance of anthropogenic climate change. This presentation will examine reasons for this scepticism and the positive role that Earth scientists can play in the debate about the consequences of atmospheric greenhouse gases. The scepticism arises from ignorance, bloody-mindedness, a Lyellian aversion to catastrophism, our training in the use of multiple working hypotheses, and our knowledge of a geologic record that shows constant change. Numerous processes act on different time scales to cause climate change. The geologic record confirms the atmospheric science predictions that abundant atmospheric carbon dioxide is correlated with times of warmer temperatures. Previous high carbon dioxide or high methane events, such as the Paleocene-Eocene Thermal Maximum and later Quaternary interglacials, provide partial analogues for current high greenhouse-gas abundance. The rate of increase in greenhouse gas abundance was likely less rapid in these past events than is now observed, making disequilibrium conditions more severe during the present event. Current changes in climate trends are those predicted by modelling greenhouse gases together with solar variability and volcanic activity.

Earth scientists provide an important perspective on the consequences of change due to global warming. The geologic record suggests that the two more catastrophic consequences of the current event, if left unchecked, could be massive methane release from permafrost areas and melting of the Greenland and/or West Antarctic ice sheets. In the geological record, the former led to spectacular extinction, whereas the latter would incorporate many densely populated urban areas into a transgressive systems tract. Not every response to human abuse of the environment can be ascribed to global warming: for example, in Bangladesh, it is flood-control structures on the coast and rivers, not rising eustatic sea level, that pose the most immediate threat to millions of people.

Many geologists were initially resistant to the concepts of plate tectonics, invented by geophysicists, just as they have been to anthropogenic global warming, invented by atmospheric scientists. Analogous to the state of plate tectonics in the early 1970's, it is becoming increasingly untenable for geologists to argue that forcing mechanisms other than anthropogenic carbon

dioxide are the principal cause of current climate trends. As a profession, we must play a more positive and influential role in the scientific debates on the nature of future climate change and its implications. The medical profession provides a useful analogue for the professional behaviour of individual earth scientists in providing a balanced assessment to policy makers and the public. As geologists, we understand the consequences of population explosions and rapid environmental changes, and we should urge the application of the precautionary principle.

Geological vignettes from York Redoubt, National Historic Site

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York Redoubt, one of the fortifications that made up Halifax's harbour defences, has stood guard atop a bedrock ridge since 1793. A National Historic Site, administered by Parks Canada, it offers panoramic views of the harbour while providing a glimpse into the region's military history.

The site provides a wonderful introduction to the geology of the region. It sits astride a contact between the two major rock units found in southwest Nova Scotia, the metamorphosed sedimentary rocks of the Cambrian Meguma Group and Devonian granitoid rocks of the South Mountain Batholith. As the two rock types look very different, this contact can be mapped quite easily by neophytes as they wander through the historic terrain. Last November, one of the authors took a group of Young Field Naturalists (and their parents) to do exactly that, with all not only surviving, but enjoying the experience.

In the process of mapping, students had to find their location on an air photo while mapping the different rock types. They also observed variability within the rock units, all the while opening their eyes to the usually "invisible" rocks beneath their feet. Some of the interesting vignettes that can be recounted include: large plagioclase and quartz crystals in the granite; enormous glacial boulders; cubic "holes" left behind from the weathering of pyrite in slate; quartz banding and veins in the metasediments near the contact; and even "stalactites" made out of Portland cement, leached out by water percolating through the concrete structures built during WWII for the operation of the anti-submarine net. And of course, there is the overarching story of the region's glacial history, carving out the harbour and creating a landscape which made the city so impervious to attack from the sea.

Following the walkabout, students were able to apply their newly-gained understanding by continuing their mapping during the car trip down Purcell's Cove Road as they passed from one rock type to another and back again all the way to the Armdale Rotary. After mapping the contact, participants compared their map to a published one (the AGS Geological Highway Map of Nova Scotia), giving them an appreciation for the astounding amount of work done by geologists who have preceded us. In this International Year of Planet Earth we have an opportunity to re-discover the Earth beneath our feet. This field trip serves as an example of similar outings wherever we might live. All that is necessary is for us to open our eyes to the diverse geological vignettes all around us waiting to be told.

Hydrogeological and geological inferences from core, well-logs, drill-stem tests and 3D seismic in the Sussex region of the Moncton sub-basin, New Brunswick, Canada

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The Lower Carboniferous Mabou Group represents a packet of continental red beds comprised of siltstone, sandstone, sandy shale, polymictic conglomerate, and coal in some places. These rocks overlie the salts of the Windsor Group evaporate, within which potash is mined at Penobsquis, New Brunswick. Aquifers within the Mabou Group present an inflow hazard to any potash mine in the Moncton sub-basin, and, in fact, the PotashCorp mine at Penobsquis has been dealing with a brine inflow into mine workings since 1998. Currently the inflow, while chronic, is manageable and has not had an impact on either potash or salt mining. However, recognising the potential consequences of such inflows, a program of investigating the hydrogeology of the Mabou siltstones was undertaken as part of a recent exploration program, when potash was discovered in the Picadilly region just south of the Penobsquis mine. A preliminary hydrogeological model for the siltstone in this region was created using well-log data (to gain basic rock-type and porosity information) and drill-stem formation testing (to confirm porosity inferences and establish formation permeability). The most useful borehole measurement was the "FMI" (Schlumberger Formation Micro-Imager) well-log, which was used to map fracture orientations (i.e.- strike & dip), and to infer whether fractures were open (fluid-filled) or sealed (gypsum-filled). Core was used to confirm these results. Borehole data were extrapolated using high resolution 3D seismic. The end result is a 3D model of the Mabou Group siltstone aquifer in the Penobsquis / Picadilly area. This study shows the Mabou siltstone to be "tight" (i.e.- low porosity and permeability) where it overlies the main zone of Picadilly potash mineralization.

Salt-related growth fault history and structural inversion in the Penobscot area, western Abenaki Subbasin, offshore Nova Scotia

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Earlier work in the western Abenaki Subbasin has established that the salt structures experienced two main phases of activity, one in the Jurassic-Early Cretaceous, the other in the Upper Cretaceous-Cenozoic, with a period of reduced activity in the "mid" Cretaceous (Aptian-Cenomanian). Although not the site of major salt structures, the fault systems in the Penobscot area are clearly linked to salt withdrawal to the north and south. Using recently publicly-released 3D seismic, this study examines the timing, magnitude, and location of growth fault displacement at Penobscot to gain a better understanding of salt movement in the area.

The amount of detail in the growth fault history is determined primarily by the number of seismic horizons that can be mapped reliably in the vicinity of the faults. This determines the number of time steps. Approximately 10 horizons were mapped in this study, stratigraphically ranging from the Upper Jurassic to Cenozoic. Two main, en echelon faults cross the Penobscot area. Numerous secondary faults complicate the structure, including a polygonal fault level at and just above the top of the Wyandot Formation. Corrections for time:depth relationships and folding in the vicinity of the faults are necessary to properly assess the growth history.

Early results of this work demonstrate that: 1) two main phases of fault motion are confirmed; 2) significant fault growth continued into the post-Eocene; 3) faults persist to within 150 metres of the modern sea floor; 4) there is evidence for fault inversion sometime in the Early Cretaceous (exact timing is yet to be determined). Whether the fault inversion is due to local salt tectonism or to broader tectonic events is unknown, but this study identifies the need for other studies in the region to better constrain the possibility of widespread structural inversion at this time.

Trinational Soil Survey: Start of a North American geochemical data base

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The need for soil geochemical data for assessing human health and environmental hazard risks is well recognized. However, at present there is no common understanding of soil geochemical background variation and its origin for those agencies dealing with human health and environmental risk assessment and management. The North American Soil Geochemical Landscapes Project - a tri-national initiative between United States, Canada, and Mexico - was designed to (1) develop a continental-scale framework for generating soil geochemistry and relevant biological and organic compound data; and (2) provide soil geochemical data that are available and useful for a wide range of applications and disciplines. This project is the first multi-national multi-agency collaboration of its kind starting with common focus and protocols.

The Project is based on low-density sample collection (40 km spacing) over a spatially balanced grid with a total of 13, 212 sites over North America, including over 6200 samples across Canada. There is a core set of Project protocols and also additional ones to meet the needs of users in each province and country. These include standardized sampling of the 0-5 cm "human health" layer, and the A-, B- and C-horizons and analysis of the <2mm and <0.063 mm fractions for selected trace, minor, and major elements (including Hg, Pb, As, and Cd) and limited organic components.

In the summer of 2007 a series of mini-surveys were undertaken to progress towards national geochemical coverage. A major initiative has been in the Maritimes where approximately 200 sample sites including 115 in New Brunswick, 55 in Nova Scotia and 10 in Prince Edward Island were taken. Samples in NB and NS were taken by the Ministry of Natural Resources. Similarly the USGS has covered a number of the New England states as well as a transect across Alaska. Mexico has started sampling and over 200 samples were taken.

In addition to the core set of parameters, a set of "add on" parameters will be assessed to determine if they should be added to the core protocols. The major component was analyzing for soil radon with the intention of creating maps of the potential of soil radon risk. This work includes ground based measures as well as airborne radiometric data. Results from the summer's work will be available by the spring of 2009.

Geology and architecture of deformation associated with the Scottie Creek fault, western Yukon

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The northwestern Canadian Cordillera is a complex assemblage of tectonic terranes defined on the basis of age, lithologies and metamorphic history. Within southwestern Yukon, the relationships of terrane boundaries remain ambiguous. The Scottie Creek fault and its associated shear zone marks the boundary between the newly defined Mirror Creek Formation and Triassic gabbro and Snowcap metasedimentary assemblage of the Yukon-Tanana terrane. Previously, the Mirror Creek Formation had been assigned to the Windy-McKinley terrane. The objectives of this study were to establish the detailed architecture across the shear zone, characterize the lithostratigraphic relationships of units and examine the kinematics of deformation. The methodology comprised detailed structural and lithological mapping in conjunction with microtextural analysis. Two primary exposures were studied, the northernmost being part of the Mirror Creek formation and the southernmost consisting of Triassic gabbros. The northern exposure consists mostly of quartz-muscovite schist, carbonate schist, quartzite and a mixed metasedimentary unit. The southern exposure is highly altered with two main lithologies, a chlorite schist and a fuchsite schist, plus a marble that does not seem to be depositionally related to the latter units. The deformation geometry is fairly consistent in

both outcrops. F_1 and F_2 folding generations are nearly coaxial to each other and trend NW-SE. S_1 and S_2 commonly cannot be distinguished from each other on the regional scale and form a composite foliation. Transposition through isoclinal folding occurs for both generations. F_1 and F_2 fold axes form a small circle around the F_3 axis, which has a general orientation of $22^\circ \rightarrow 211^\circ$ and is defined by crenulations as well as open folds. S_3 foliation is rare, and where found is a discrete, spaced cleavage. Microstructural work shows development of complex tectono-metamorphic fabrics that correlate with the macroscopic field observations.

Post-glacial tsunami hazard for eastern North America: real or imagined?

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There have been few documented tsunamis along the coasts of eastern Canada (5900BC(?), 1755, 1864, 1848, 1914, 1929, 2004) and the U.S. (5900BC(?), 1755(?), 1926(?), mid-1930s, mid-1960s, 2004). Known large marine or near coastal earthquakes are limited to 1886, 1929 and 1933. Thus need we be concerned about tsunamis as a potential coastal hazard?

Very clear post glacial faults (pgfs) have been documented in Fennoscandia with lengths of 50 km and throws up to 10 m; such faults would have had magnitudes >8.0 – even up to 9. It is believed that pgfs occur in rapidly deglaciating areas where zones of differential crustal strain can build up to trigger a seismic release. If such pgfs are known in the Fennoscandian shield is there any reason why they might not occur in the Greenland or Canadian shield during or soon after deglaciation? However in Canada until recently no pgfs have been identified. The Dec. 25, 1989 Lac Turquoise 6.3 magnitude earthquake in the Ungava area of N. Quebec broke the surface of the shield for 8.5 km with reverse throws up to 1.8 m. This appears to be a modest pgf. In north central Manitoba the pre-historic Holy Grail Fault is at least 20 km long and forms a very evident curvilinear fault scarp of at least 5 m height in Lake Agassiz varved clays. This pgf appears to have occurred beneath glacial Lake Agassiz raising the possibility that it was tsunamigenic and that Manitoba experienced Canada's first known tsunami! If pgfs can occur beneath a glacial lake can they occur below the ocean and cause tsunamis? Marginal marine channels are common off most glaciated coasts. These linear topographic lows are eroded by seaward-flowing continental ice sheets along the contacts between the onshore crystalline cratonic shield rocks and the offshore younger fringing sedimentary strata. Such marginal channels are known all around Canada's glaciated coasts, off Greenland and off Norway and may represent up to 100 m of glacially eroded rock giving rise to additional differential crustal strain during deglaciation. Alan Grant at the GSC Atlantic mapped apparent pgf fault scarps in the offshore Labrador Trough which is a pronounced marginal channel. These pgfs will have been tsunamigenic. The tsunamigenic Storegga Slide of 7900 y BP off NE Norway has moved ~20,000 cu km of continental slope sediment; no cause for the slide is known but to postulate an offshore, or coastal, pgf is a very reasonable suggestion. This then leaves us with the question of 'where might future pgfs occur indeglaciated areas in view of possible climate change or climate variability?' The coasts of Svalbard, Greenland, Baffin Island, Devon Is. and perhaps N. Labrador may all be the source of submarine pgfs that may be tsunamigenic or which may shake loose significant volumes of ocean floor, or continental slope sediments, to cause significant landslide tsunamis. In either case such events could threaten both the coasts of eastern N. America and parts of western Europe.

Nova Scotia case studies of radon soil gas distribution and mobility

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Radon is a radioactive noble gas that is formed by the decay of radium, which in turn is a product of the decay of uranium. All soils have radon present, and the concentration of this gas is dependant on the nature of the underlying bedrock, composition of the soil, permeability and porosity of the soil, and the organic content of the soil. In Nova Scotia there are numerous radon soil gas anomalies. The areas of high radon soil gas at Three Mile Plains near Windsor are related to uranium enrichment in the Horton Group sandstones and shales, whereas the radon soil gas anomaly at Reeves Road near New Ross is related to saprolites developed on the granites. In the Reeves Road occurrence a strong disequilibrium occurs, with radium concentrations greatly exceeding the uranium content of the weathered granite horizon, indicating that uranium has been mobilized out of the horizon and radium remains. Radon mobility within soil horizons in Nova Scotia can also be linked to groundwater movement. The concentration of radon in the atmosphere is very low and, therefore, radon-rich groundwater will lose radon by volatilization. The saturated zone of a soil, therefore, usually has a higher radon content than the unsaturated zone.

Synergy between terrestrial and space technologies: auto-synchronized 3D laser imaging and electromagnetic induction sounding

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Technological development for terrestrial and space applications is often closely interrelated. In one scenario, a proven terrestrial technology or scientific instrument is ported to space. Inversely, technologies developed for the rigors of space can find new uses in challenging terrestrial environments. This presentation will focus on two versatile Canadian technologies adapted to both terrestrial and space applications: auto-synchronized 3D laser imaging and electromagnetic induction sounding.

The principle of auto-synchronized 3D laser imaging originated at the National Research Council in Ottawa and was later adapted for space by Neptec Design Group of Kanata, Ontario. Neptec's Laser Camera System (LCS) projects an infrared laser beam on a target with rotating mirrors, and focuses the reflected light onto a linear detector array to obtain 3 spatial coordinates and intensity (X, Y, Z, I). The system is currently used during shuttle missions on low-earth orbit to inspect the orbiter's tiles for potential damage following liftoff. In an interesting twist, the system has recently found new terrestrial applications: non-intrusive measurement of the volume of rare and fragile meteorites, and fracture mapping in an underground mining environment.

Canada is a world leader in electromagnetic geophysical techniques, which have been credited with numerous mineral deposit discoveries since World War II. In electromagnetic induction, a transmitter outputs a time-variant, primary magnetic field which generates electrical currents in the subsurface. These currents, in turn, induce a secondary magnetic field which is recorded at the receiver. The Electromagnetic Induction Sounder (EMIS) is a compact instrument based on this principle. Hosted in a one-metre long tube, the instrument measures the electrical conductivity and magnetic susceptibility in the few first metres of the subsurface, e.g. for the characterization of agricultural soils and ice wedges in arctic polygons. The EMIS is of interest to the space community because of potential use to detect brine pockets in the near-subsurface of Mars.

Chemical and Sm-Nd isotopic constraints on the provenance and tectonic setting of late Neoproterozoic and Cambrian sedimentary and metasedimentary rocks in Avalonia of southern New Brunswick

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Neoproterozoic though Cambrian clastic sedimentary and/or metasedimentary rocks occur in the Hammondvale Metamorphic Suite (> ca. 620 <680 Ma) and Broad River (ca. 620 Ma), Coldbrook (ca. 560-542 Ma) and Saint John (ca. 540-490 Ma) groups in the Avalonian Caledonia terrane of southern New Brunswick. The petrographic, major and trace element chemical, and Nd isotopic compositions of the sedimentary rocks provide constraints on the provenance and tectonic setting of these units and hence on the tectonic evolution of this typical part of Avalonia.

Nd isotopic and whole-rock chemical data show that the Hammondvale Metamorphic Suite and metasedimentary rocks of the Broad River Group have negative ϵ_{Nd} values, were derived from recycled sedimentary and mafic igneous sources, and were deposited in intra-arc basins as part of the ca. 620 volcanic-arc complex. In contrast, sedimentary rocks of the Coldbrook Group show generally positive ϵ_{Nd} values and likely were derived from Avalonian felsic to intermediate igneous sources and deposited in rift basins associated with 560-550 Ma arc extension. Samples from the overlying Saint John Group have felsic to mafic igneous sources, but are characterized by negative ϵ_{Nd} values and likely were deposited as part of a newly forming passive margin sequence.

Many metasedimentary and sedimentary samples from the Hammondvale Metamorphic Suite, Broad River Group, and Saint John Group fall outside the normal Nd isotopic range for Avalonian igneous rocks, whereas Coldbrook Group samples fall mainly in the typical Avalonian igneous Nd isotopic range, suggesting a substantially larger Avalonian crustal component in their evolution. Based on their mostly positive ϵ_{Nd} values, the sedimentary units in the Coldbrook Group were most likely derived from associated volcanic units as well as the older Broad River Group igneous units. The more negative ϵ_{Nd} values for samples from the Hammondvale Metamorphic Suite and Broad River Group indicate a large, isotopically mature source from more interior locations in Gondwana. Based on overlapping detrital muscovite ages and similar Nd isotopic values, the lower Saint John Group units were derived from the Hammondvale Metamorphic Suite, whereas the middle to upper units, which have more evolved Nd isotopic values, appear to require a source outside of the Caledonia terrane.

Phosphate Deposits in Cambrian Rocks of Avalonia in the Saint John area, New Brunswick

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Unusual black sandstone beds of Cambrian age (~530 to 511 Ma) occur in the upper part of the Glen Falls Formation and the lower part of the overlying Hanford Brook Formation of the Saint John Group in the Saint John area of southern New Brunswick. The dark color of these beds has been attributed to phosphatic minerals and iron chlorite. The ubiquitous presence of phosphorous, an essential nutrient for life, is important as these rocks formed during the time of the "Cambrian Explosion" in the early evolution of life. This project focuses on mineralogy, origin, and depositional environment of the black sandstones, as well as their disputed stratigraphic relationships with overlying and underlying rocks, and the phosphorous cycling that took place during deposition. The study will investigate also the correlation between the evolution of life as recorded in the Saint John Group and the appearance of phosphorite.

Phosphorite is defined as a marine sedimentary rock with equal to or greater than 18% P_2O_5 . The sedimentary phosphate mineral is francolite. The origin of phosphorite involves phosphorous in particulate organic matter being transferred to sediment, followed by diagenetic degradation and dissolved inorganic phosphorous being released from the organic matter to sedimentary pore waters, causing the precipitation of francolite. This process produces phosphorite hardgrounds, as well as individual grains or concretions that become reworked, forming concentrated phosphorite beds. The phosphorite that occurs in the Glen Falls and Hanford Brook formations was likely linked to sea-level rise at the Precambrian-Cambrian boundary and iron-redox cycling. These events allowed more phosphorous to be available for life forms.

Fifty-two samples were collected from outcrops in and around the Saint John area and stratigraphic sections were logged for each location. The stratigraphic sections have been compared for lateral and stratigraphic variations. Interpretations of seven lithofacies described in these outcrops suggest deposition was in a tidal barrier island environment to mid-to-distal shelf environment. Thin sections of samples have been cut and examined using both petrographic and scanning electron microscopy to aid in determining paragenesis. Results confirm that francolite occurs as firmgrounds, intraclasts, and coated grains. SEM-EDS was used to determine the chemical composition of the phosphorites. Five samples were sent to the Queen's Facility for Isotopic Research where stable isotope compositions for carbon ($\delta^{13}\text{C}$) are being determined by ICP-MS; these data will aid in the interpretation of depositional conditions.

$^{40}\text{Ar}/^{39}\text{Ar}$ Age Dating of Three Shear-Zone Hosted Gold Occurrences, Northern New Brunswick

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Gold mineralization at the Elmtree, Middle River and Tetagouche Falls deposits is focused in ductile to brittle fault zones where hydrothermal fluids have overprinted Ordovician to Silurian host rocks. The gold occurs in sulfides as submicroscopic inclusions or lattice constituents of auriferous arsenopyrite-pyrrhotite± (arsenian) pyrite±chalcopyrite contained within quartz-carbonate veins or disseminated in the adjacent wall rocks. Sericite alteration (proximal) is intimately associated with Au mineralization in all three deposits. Other types of alteration including carbonatization, chloritization, and silicification (jasperoid formation) are more distal.

Six whole rock powders of drill-core samples from the sericitic alteration associated with each deposit were submitted for $^{40}\text{Ar}/^{39}\text{Ar}$ step heating to evaluate the timing of mineralization. Both Tetagouche Falls samples (n=2) yielded plateau ages of 420 ± 2 Ma (Ludlow) and 436 ± 3 Ma (Llandovery). The Middle River sample (n=1) gave a proper plateau age of 434 ± 3 Ma (Llandovery). The Elmtree samples (n=3) did not give a plateau, but yielded ages ranging between 430 and 420 ± 4 Ma (Llandovery-Ludlow). For all samples the K/Ca and K/Cl ratios are not well correlated with age, suggesting a difference in the chemical composition of sericite between the low-temperature and high-temperature steps, later thermal overprinting, or the influence of other K-bearing phases.

Although the dataset is limited, two $^{40}\text{Ar}/^{39}\text{Ar}$ age plateaus are interpreted: one ≥ 430 Ma and the other circa 420 Ma. The older age is interpreted to reflect peak metamorphism (ca. 442–430 Ma) in the Brunswick subduction complex resulting from closure of the Tetagouche–Exploits back-arc basin. The age of 420 Ma is interpreted to reflect the timing of hydrothermal sericite formation coincident with Au mineralization, and is supported by the observation that mineralization extends into Wenlock-Ludlow sedimentary rocks at Elmtree.

The 420 Ma age of mineralization is significant in terms of regional tectono-stratigraphy as it is coeval with exhumation of the Brunswick subduction complex during the Wenlock (ca 428–418 Ma) and manifested by conglomerates containing erosional detritus from this complex. Exhumation occurred during oblique convergence of the Miramichi Zone (Ganderia) with Laurentia and was accompanied by strike-slip movement along major faults, i.e. Rocky Brook-Millstream and Elmtree faults, which acted as conduits for mineralizing fluids. Locally, mafic dykes that are altered and mineralized cut the Wenlock conglomerates and farther west in the Chaleurs Bay Synclinorium, there are mafic lavas that are coeval with these conglomerates. The 420 Ma age is clearly older than the major felsic intrusions in the area, i.e., Antinouri Lake Granite ≈ 372 Ma and Nicholas Dénys Granodiorite ≈ 381 Ma, meaning that Au mineralization is not linked to felsic plutonism.

Spatial and temporal evolution of the Rockeskyllerkopf volcanic centre, west Eifel volcanic field, Germany

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The Rockeskyllerkopf volcanic center (RVC) is part of the Quaternary West Eifel Volcanic Field. As a first step towards understanding the dynamics of the plumbing system, we have studied the volcanological evolution of the RVC and examined the evolution of the magmas and their source. The RVC comprises three distinct but overlapping centers that evolved over an extended period of time from distinct mantle sources. The oldest center, the SE Lammersdorf Center (SEL), was dominantly phreatomagmatic and formed a tuff ring. The earliest eruptions developed from pulses of magma transported rapidly from the mantle source; the lack of mantle xenoliths and more evolved geochemical signatures in the later SEL deposits indicate significant fractionation and possible development of a magma chamber. Phlogopite from the second eruptive event yields an $^{40}\text{Ar}/^{39}\text{Ar}$ -age of 480 ± 50 ka. A phlogopite megacryst gave an isochron age of 643 ± 11 ka, implying an earlier phase of intrusion at depth, the products of which were subsequently entrained by the migrating SEL magmas. The second and dominant center, the Rockeskyllerkopf Center (RKK), lies to the SW and forms an elongate edifice parallel to one of the regional fault orientations. This center also comprises three distinct units; a lower spatter unit with overlapping cones aligned along a fissure, followed by well-bedded airfall deposits that are in turn overlain by another sequence of spatter, the later of which are closely associated with a dyke. Eruptions were more magmatic than those of the SEL center. This episode was followed by a significant hiatus during which weathering led to local soil development. The soil is overlain by an ash flow tuff deposited

during the vent-clearing event that marked the onset of the last eruptive episode the Franzosichebuche (FB) center. This dominantly strombolian episode produced a small cinder cone. The final eruptions produced clastogenic lava flows, the distribution of which were controlled by local paleotopography. The lavas of the RVC are clinopyroxene and olivine phyric leucites and nephelinites. Magma compositions reveal evidence for limited fractionation of clinopyroxene and olivine in various proportions, generally consistent with the observed phenocryst assemblages. Major and trace element signatures indicate distinct sources for all three centers implying a combination of variable degrees of partial melting and vertical and lateral heterogeneity in the source region.

2007 Deep-water marine seismic acquisition to define the Canadian Extended Continental Shelf under Article 76 of the United Nations Convention on the Law of the Sea

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The United Nations Convention on the Law of the Sea (UNCLOS) establishes under international law the concept of the 200 nautical mile exclusive economic zone (EEZ) allowing coastal states to exercise jurisdiction for the purposes of exploration, exploitation, conservation, and management of natural resources of the water column, seabed, and subsoil. Beyond the EEZ, there is also provision, under Article 76, for coastal states to define an Extended Continental Shelf (ECS) within which they may exercise jurisdiction over resources of the seabed and subsoil. Canada ratified the UNCLOS in November 2003 and has ten years from that date to submit a claim for an ECS to the UN Commission on the Limits of the Continental Shelf. The government allocated \$70 million to the Department of Fisheries and Oceans and to Natural Resources Canada in September 2004 to acquire and compile all the necessary data and, with Foreign Affairs and International Trade Canada, to prepare the claim.

The Canadian claim will be based on existing and newly-acquired geophysical datasets including single- and multi-beam bathymetry, spot soundings, gravity, magnetics, and seismic reflection and refraction surveys. During the 2007 field season, 9800 km of seismic data were successfully acquired over continental slope, rise, and abyssal plain regions of the Atlantic and western Arctic margins of Canada. In the eastern Arctic, heavy ice conditions thwarted attempts to collect seismic data along the Canadian margin even though two icebreakers were used and one of them is considered to be the most powerful in the world.

The new datasets acquired specifically for the UNCLOS project are confidential until the Canadian claim is accepted by the UN. However, selected examples and important scientific results will be published as the data are analysed. Also, collaborations are being fostered with researchers in universities and other government departments to minimize costs and to take advantage of logistical opportunities to acquire complementary datasets. This poster presents an overview of the datasets that were acquired in 2007.

The Lower Devonian North Pole Stream Pluton: A strongly peraluminous granitic complex hosting a polymetallic vein-type uranium deposit, New Brunswick, Canada

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The North Pole Stream Pluton (NPSP) underlies an area of about 500 km² between Trousers Lake and Big Bald Mountain in north-central New Brunswick. Magmatic fractionation produced four, probable, comagmatic differentiates namely: biotite granite (oldest phase); biotite-muscovite granite; muscovite granite; and quartz-feldspar porphyry (QFP) granite that crosscuts all other phases of the pluton.

Existing petrochemical data for the NPSP suggest that the muscovite granite is the most highly evolved phase in that it has A/CNK = 1.3-1.4, a P/Ca higher than apatite, has low Σ REE (8.4 ppm), Zr/Hf (16.8), Nb/Ta (5.9), and Th/U (0.04), and is enriched in Rb (542.3 ppm), Sn (30.7 ppm), Nb (51.8 ppm), Ta (8.8 ppm), and U (28.5 ppm). The fractional crystallization of monazite, xenotime, zircon, and apatite in the muscovite granite produced extreme depletions in HFSE's and the REE's, and chondrite-normalized REE patterns with low LREEs/HREEs and a slight discontinuity between Nd and Sm.

Other phases of the pluton are far less fractionated and represent a continuous differentiation series that becomes increasingly more perphosphorus and uranium-specialized with decreasing age. The excess P is located primarily in K-feldspar, is enriched in the rims compared to the core of the grains, and increases in concentration with decreasing age of the host-granitoid. Ba and Cs have a similar relationship in K-feldspar; however, their concentrations decrease with increasing degree of fractionation.

A number of radiometric ages have been reported from the NPSP. A sample of biotite granite obtained from approximately one half kilometre south of the study area has yielded a U-Pb monazite age of 417 ± 1 Ma, and has been interpreted as the emplacement age of the NPSP. A ten-point whole-rock isochron from the biotite to the east of the map area gave an age of 387 ± 7 Ma with an initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratio of 0.703. A muscovite K-Ar age of 414 ± 5 Ma and a Rb-Sr age of 381 ± 4 Ma have been reported from one sample of muscovite granite and, from another sample, Rb-Sr ages of 425 ± 4 Ma and 397 ± 4 Ma have been obtained from muscovite and biotite respectively. Recent CHIME dating of quartz-hosted monazite inclusions in the muscovite granite has yielded an age date of 421 ± 6 Ma, implying the monazite inclusions pre-date the muscovite granite and are inherited from an earlier phase in the crystallization history.

The Long Lake polymetallic vein-type uranium deposit is located near the southwest end of the NPSP. The mineralization occurs in hydrothermally altered, and highly brecciated, northwesterly trending fractures that follow the regional structural trend and are parallel to the orientation of QFP dykes. The parallel orientation and the proximity of the veins to the QFP dykes imply a cogenetic relationship between the youngest phase of the NPSP and the uraniferous veins.

What is Climate Change? Engaging the public in a critical discussion

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During the past 18 months, the author has presented a talk entitled “Weather, Climate Change and Global Warming, what Al Gore didn’t tell you!” to high school classes and service groups throughout Nova Scotia. Weather, as distinguished from climate, consists of the short-term (minutes to months) variations of the atmosphere. Climate change refers to the “...statistically significant change in measurements of either the mean state or variability of the climate for a specific place or region over decades to centuries”. Alternatively, climate change has also been referred to in the press “as the process by which human emissions of greenhouse gases are believed to be causing changes in the Earth’s climate system”. Audience feedback during the author’s presentations has shown that there is much confusion over what constitutes climate change and how to place local and regional climate variability in the context of global warming.

The author will discuss how his presentations resulted in a lively discussion of the differences in atmospheric phenomena and how an understanding of the differences might better inform the public’s critical assessment of climate change policy and potential adaptation and mitigation strategies. As well, the author will discuss the reaction of the audience to the contention that pollution of the planet may be a more significant problem than global warming.

Partial digestions in soil geochemical exploration: How buffering, adsorption, and mineral stabilities influence data processing and interpretation

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In the 1990’s, many commercial geochemical laboratories introduced ostensibly new, proprietary partial digestions for the analysis of soil samples from mineral exploration programs. These digestions were designed to solubilize specific components of soil samples (*e.g.*, those components transported from depth through exotic overburden to the surface) so that high geochemical contrast allowed reliable recognition of transported element anomalies. Unfortunately, the reception these proprietary digestions received from geoscientists has been highly variable: some geoscientists ‘believe’ in their worth as effective exploration tools, whereas others pan them as ‘snake oil’. Furthermore, the performance level of these techniques has generally been disappointing, partly because no exploration technique is infallible, and partly because proper data interpretation is virtually impossible when the reagent chemistry used to solubilize a sample is unknown.

Factors that typically must be considered when evaluating what component of a soil sample has been put into solution, and thus providing insight into how to interpret geochemical anomalies, are: (i) the geochemical behavior of the pathfinder element, (ii) the stability and adsorptive behavior/characteristics of the mineral in/on which it resides, (iii) the equilibrium pH and pe of the soil in deionized water, (iv) the pH and pe of the reagent before and after digestion, (v) the presence of buffers in the reagent, (vi) the behavior of exchangeable ions in the reagent, and (vii) the presence of ligands in the reagent. Obviously, last four factors are not known when using a proprietary leach, but need to be to properly data process and interpret the cause of a soil geochemical anomaly.

For example, if Zn is adsorbed onto the surfaces of poorly crystalline Fe-oxy-hydroxides (*e.g.*, ferrihydroxide, goethite and hematite) in a soil, and a weak solubilizing reagent (say, $MgCl_2$) merely causes cation exchange of Mg^{+2} for the adsorbed Zn^{+2} , then two factors could control the Zn concentration in the resulting solution: the amount of Fe-oxy-hydroxide in the soil, and the amount of soluble Zn available for adsorption to the soil (a factor probably related to the presence of mineralization). More Fe-oxy-hydroxide could produce a Zn anomaly merely because more adsorption of Zn could take place. Consequently, dividing the Zn concentration by the amount of readily soluble Fe would remove (standardize) these variations, leaving the variations caused by differing amounts of soluble Zn available for adsorption. However, if Pb occurs in elastically dispersed galena grains, and an oxidizing agent (say, nitric acid) oxidizes the sulphide, breaking down galena and liberating Pb, then examining the Pb concentration as an individual variable represents an appropriate data processing and interpretive strategy. Obviously, understanding the mineralogical and geochemical properties of soil samples and the behavior of partial digestion reagents are both required to identify the appropriate manner in which to evaluate and interpret geochemical soil anomalies.

Physical evidence of a late-glacial (Younger Dryas?) impact event in southwestern Nova Scotia

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An oval structure in southwestern Nova Scotia measuring 350 x 420 m has been identified as a possible Late-Glacial age impact crater. Evidence for an impact origin is based on integrated analysis of geomorphic, magnetic, petrographic, ground penetrating radar and stratigraphic data. A magnetic survey of the site indicates that the regional linear magnetic pattern in granitic rock is interrupted and distorted within the raised crystalline crater rim, due either to shock remagnetization or reorientation of broken blocks. Probable shock-metamorphic features in rim rocks, not present in unaltered rocks outside the structure, include common single and multiple sets of closely spaced (~4-15 µm) planar microstructures in quartz and feldspar, kink-banded feldspar and biotite, reduced mineral birefringence, rare diaplectic feldspar and rare melt veinlets with flow textures. Fresh grain comminution, grain mosaicism and other lattice distortion features are pervasive.

Ground penetrating radar shows that the crater has a depressed inner floor that is sharply ringed by a 10-m-high buried scarp. Heterogeneous material under the floor, interpreted as ejecta fallback or slumpback deposits, is overlain by stratified and faulted lacustrine sediment. A Late-Glacial age is inferred through similarities in sedimentation rates to nearby bogs with well-constrained ages and the lack of any evidence of ice-sheet reworking and associated glacial deposits. Strata within the structure appear to be wedge-shaped, indicating post-glacial differential subsidence and compaction. In addition to the main crater, a cluster of arcuate, rimmed scarps 1 km north of the structure may record additional smaller impact sites, suggesting the impactor fragmented upon entry into the atmosphere producing a crater field. The oval shape of the main crater may also indicate an oblique impact or impact doublet. Continuing research focuses on identifying ejecta material in lake sediments from southwestern Nova Scotia in order to elucidate any potential link to Late-Glacial environmental change.

Investigating flood risk in an ungauged watershed using LiDAR, GIS and HEC TOOLS

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This study was initiated because there is a concern over the predication and recurrence of significant flooding in the town of Oxford, Nova Scotia. The Oxford watershed is ungauged and modelling parameters required for HEC-HMS were derived based on the analogous, gauged, River John watershed. Voronoi polygons were used to distribute precipitation within the watersheds and Soil Conservation Society curve numbers were calculated using LandSat ETM+ imagery and soil drainage data. Base flow was calculated using a ratio to peak of 0.11 and recession constant of 0.87. The constant rate of infiltration is 0.074m/hr. Recurrence intervals calculated for the Oxford watershed show that the September 1999 flood was a 1 in 23 year event and that 10, 25 and 100 year floods have flows of 156 m³/s, 197 m³/s and 258 m³/s respectively. Using these flows, inundation was calculated and flood risk maps were produced using HEC-RAS. This study has developed new and repeatable techniques for simulating flooding events in rural Nova Scotia by using LiDAR intensity and height data as an indicator of friction and selecting an analogous basin for use in the HEC-HMS modelling system. Sensitivity analysis shows that SCS curve number is by far the most important factor in watershed modelling and variations by 10 % result in recurrence interval peak flows of between 8% and 10%.

500 million years of episodic anorthosite/leucogabbro – granodiorite/monzogranite (ALG) magmatism in the Archean Yilgarn craton

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The Narryer Gneiss Complex (NGC) of Western Australia is one of largest intact blocks of early-middle Archean rocks (3.7 – 3.2 Ga) preserved on Earth. New laser ablation-inductively coupled plasma-mass spectrometer (LA-ICP-MS) U-Pb zircon geochronology and whole rock geochemistry of twenty-five NGC orthogneisses suggest that the terrane formed largely from episodic, bimodal anorthosite/leucogabbro – granodiorite/monzogranite (ALG) magmatism. Trondhjemite-tonalite-granodiorite (TTG) and dioritic magmatism, common in many Archean terranes elsewhere, is rare in the NGC. ALG suites represent a newly-defined, distinctive magmatic association for the Archean, similar in some respects to Mesoproterozoic Anorthosite-Mangerite-Charnokite-(Rapakivi) Granite (AMCG) suites.

The gneiss samples were collected from north of the Jack Hills and northwest of Mount Dugel. LA-ICP-MS U-Pb zircon ages cluster at 3720Ma, 3680Ma, 3620Ma, 3490Ma, 3320Ma, and 3260Ma. Each of the age populations includes granodiorite/monzogranite gneisses, and all except the two youngest populations consist of anorthosite/leucogabbro gneisses. The granite gneisses have remarkably similar bulk compositions, independent of age: they are all moderately peraluminous (alumina saturation indices of 1.05 to 1.1) potassic granodiorites and monzogranites, quite unlike their more well-known Archean, sodic TTG counterparts. Formation of the ALG magmatic association is not easily reconciled with convergent plate

tectonic processes (subduction). Its existence suggests that a major mechanism of mantle heat loss before 3.2 Ga was by episodic, but long-lived, within-plate magmatism in intra-continental rifts or at hot spots.

Petrographic, chemostratigraphic, and alteration analysis through the deformed volcanosedimentary sequence hosting the Boomerang massive sulfide deposits, Tunks Belt, Central Newfoundland

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A detailed study of 8 drill holes through the Cambrian to mid-Ordovician rocks of the Tunks Volcanic Belt that hosts the 1.3 Mt Boomerang massive sulfide deposit in Central Newfoundland is an attempt to unravel the complicated host stratigraphy and enhance correlations in this belt. The deposit strikes at approximately 225° and dips 80° to the NW. Rock types include various felsic, intermediate, and mafic pyroclastic rocks (ash tuffs, lapilli tuffs, and agglomerates), mafic to intermediate dykes and sills, and sedimentary rocks (greywacke, grey siltstone, graphitic argillites, and carbonaceous phyllites).

The hanging wall tuffs are composed of approximately 50% fine grained quartz with rare quartz and feldspar phenocrysts (10%), 30% fine-grained muscovite with minor sericite, and rare carbonate and sulfides; dominantly pyrite with very rare base metals and rare accessory minerals. The footwall tuffs differ with increased fine-grained muscovite and sericite up to 50% with 30% fine-grained quartz and increased base metals including sphalerite with less chalcopyrite and galena.

Immobile elements and their ratios prove very useful in stratigraphic interpretation. Four populations of dykes and sills have been identified, ranging from basaltic andesite to rhyolitic dacite, based on element abundances and ratios including (Winchester and Floyd inverse ratio numbers in italics) TiO_2/Zr (213.1, 98.97, 51.04, 83.79) (0.0048, 0.010, 0.020, 0.013), Y/Nb (10.6, 5.51, 4.30, 10.1) (0.098, 0.20, 0.24, 0.10), $\text{TiO}_2/1000$ (9.45, 13.1, 9.28, 7.10), Y+Nb (20.5, 29.3, 35.8, 29.6), Zr/Y (2.43, 5.49, 6.40, 3.14), Zr (45.56, 136.1, 182.4, 83.79), V (399.9, 232.5, 108.3, 45.29), Y (18.6, 24.4, 29.0, 26.8), Nb (1.81, 4.92, 6.75, 2.76), Rb (7.00, 18.8, 28.9, 14.94), and Th (2.00, 3.75, 6.25, 2.74). The footwall and hanging wall tuffs are geochemically very similar shown by element ratio averages of (Winchester and Floyd inverse ratio numbers in italics) TiO_2/Zr (HW=77.22, 0.026, FW=85.20, 0.018), $\text{Al}_2\text{O}_3/\text{Zr}$ (HW=2062.51, 0.0007, FW=2432.66, 0.0005), Zr/Y (HW=3.98, FW=4.12), TiO_2/Y (HW=244.23, 0.006, FW=280.34, 0.004), $\text{Al}_2\text{O}_3/\text{Y}$ (HW=6995.25, 0.00018, FW=8717.30, 0.00013), $\text{TiO}_2/\text{Al}_2\text{O}_3$ (HW=343.17, FW=328.22), Th/Nb (HW=1.20, FW=1.03), and Zr/Th (HW=3.98, 0.033, FW=4.12, 0.034) and range from basaltic andesite to rhyolitic dacite.

Towards the ore horizon deformation increases in intensity with two directions of foliation which are enhanced by increased sericite. The alteration system and stockwork zone are recognizable by: (1) increased Fe-rich chlorite and disseminated and veined sulfides in the hanging wall; and (2) intense sericite alteration with increased disseminated and veined base-metal sulfides in the footwall. This is consistent with the fact that $\text{Al}_2\text{O}_3/(\text{Al}_2\text{O}_3 + \text{K}_2\text{O} + \text{Na}_2\text{O})$ increases with proximity to the ore horizon.

Monazite as a provenance indicator for the Lower Cretaceous reservoir sandstones, Scotian Basin

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Electron microprobe geochronology on detrital monazite grains was determined to understand the provenance of sediment supplied to the Lower Cretaceous deltas of the Scotian Basin, to interpret distribution of river mouth facies and to understand variability in diagenesis and hence reservoir quality. Previous work demonstrated the use of detrital monazite in the fluvial facies of the Lower Cretaceous (Chaswood Formation).

197 detrital monazite grains from 13 wells and different stratigraphic levels of the Lower Cretaceous of the Scotian Basin have been dated by electron microprobe and groups of monazites of similar age have been characterised by backscattered electron imagery and REE chemistry. After removing analyses showing errors greater than 20% (resulting from interference of Y and Th in Pb peaks, and Th in U peaks) and single analyses that were extreme outliers, ages from 651 analyses were interpreted. Based on their REE abundance, monazites were classified into 4 types (A–D). Moreover, X-ray maps were made from selected grains and histograms and cumulative probability plots were produced for each well.

Detrital monazite from western Scotian Basin (Naskapi N-30) yielded Carboniferous ages. In the central Scotian Basin (Alma K-85, Thebaud C-74, I-93 and 3, Glenelg E58 and E58A, Venture 1, 3 and 4) Devonian and Silurian – Devonian ages are the dominant populations in both the Logan Canyon and Missisauqua formations, and a small peak at 500 Ma is found at Venture. Proterozoic ages, present throughout the central part of the basin, are the second largest population. In the eastern Scotian Basin, Mesoproterozoic ages dominate in the Peskowesk A-99 well, whereas in the Tantallon M-41 the majority of the ages are Silurian – Devonian. Based on REE patterns, there is a clear discrimination between the western Scotian Basin (Naskapi N-30), where types C and D predominate, and the central and eastern part of the Basin where type A and B type patterns are more abundant.

Variation in detrital monazite age and composition suggest that several rivers transported sediment from multiple bedrock sources. At least one river supplied material to the western part of the Scotian Basin, as indicated by the Carboniferous ages and the distinctive dominant REE patterns. In the eastern part of the basin (Peskowesk A-99) the dominant ages are Proterozoic

and type C REE patterns are absent, indicating that this part of the Scotian Basin was fed by a different river relative to the one(s) that supplied material to the central part of the basin.

Geochemical identification of clastic sediment provenance from known sources of similar geology: the Cretaceous Scotian Basin, offshore eastern Canada

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This study tests the effectiveness of a geochemical approach in identifying provenance in a basin where different sources do not show strongly contrasting geology. Petrological studies indicate that at least three distinct rivers, draining reactivated horsts of the Appalachian orogen, supplied sediment to the Lower Cretaceous deltaic sandstones and mudrocks in the offshore Scotian Basin. 95 samples mostly from conventional core were analyzed for 44 major and trace elements. The data were first screened for variability unrelated to provenance, including changes in elemental abundance due to weathering and diagenesis, and the effects of grain size and sorting on element variation. The effect of hydraulic sorting was distinguished from the effects of concentration of ultrastable heavy minerals from polycyclic sources. Multivariate statistical analysis by principal component analysis (PCA) was used to test the hypothesis of three discrete sources suggested by the petrologic model. Major element PCA on sandstones discriminated the sources but results from trace element PCA required further investigation using element biplots to understand their significance. Only a few elements were found to be diagnostic of different sources, namely K, Rb, Sr, U, Th, Nb and Ti, with the latter two of value only for sandstones. These are all elements that are abundant in the granites of the Appalachians. Most published geochemical discrimination diagrams did a poor job of distinguishing the three petrographically recognized sources. In other basins with quite different hinterland geology, other elements are known to be of value in discriminating provenance. Thus it is unlikely that a globally applicable set of elemental discriminants can identify terrigenous sediment sources. Rather, systematic investigation is needed that evaluates processes such as diagenesis and sorting and then tests geographic and stratigraphic variability in bulk geochemistry, informed by at least semi-quantitative petrographic data.

Dendroclimatic response of alpine treeline species in Central Labrador: a multi-species perspective

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This study presents the first black spruce, balsam fir and larch tree ring width chronologies from Labrador. It uses a multi-species perspective to study the radial growth response of alpine treeline species in the Mealy Mountains to local and regional climate variables using bootstrapped correlation analysis. The radial growth response of black and white spruce trees is positively sensitive to growing season air temperatures and sea surface temperatures (SSTs) in the vicinity of the Grand Banks. Moisture originating from warm SSTs in the adjacent Labrador Sea appears to affect moisture-sensitive white spruce and balsam fir trees negatively in the Mealy Mountains.

Comparative analysis of 4 tree-ring time series indicates that periods of larch sawfly outbreaks have occurred in the Mealy Mountains and that these events exert a significant amount of influence on the radial growth of larch trees in the Mealy Mountains. These inferred periods of insect infestations coincide with others reported in Quebec.

Growing season (June-September) temperature is reconstructed for the Mealy Mountains using merged spruce tree ring width chronologies (1847-2004). The reconstruction is in accordance with other reconstructions at regional and hemispheric scales. The sensitivity of spruce trees to local temperature and precipitation is unstable throughout the period of instrumental record due to moisture effects. Further, spruce trees in the Mealy Mountains show evidence of divergence from air temperatures over the last several decades.

Unravelling the sources of the thick Miocene pyroclastic flows, Kos (Greece)

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Kos is one of several localities (Samos, Patmos, Bodrum) in the southeast Aegean Sea with Upper Miocene volcanic rocks. The stratigraphic succession of flows, ignimbrites and interbedded sediments were studied in the field in order to better understand the age, distribution, source and tectonic setting of Upper Miocene volcanic rocks of Kos. Previous radiometric dating shows that the age of the volcanism is about 10 Ma.

In northern Kos, thin andesite flows and dacite domes are overlain by thin pyroclastic rocks near Profitis Ilias and at Tripa; north of Ag. Fokas, a thin pyroclastic succession includes lahars. In southern Kos, pyroclastic successions totalling 80 m in thickness are interbedded with Miocene clastic sediments and marls at Ag. Fokas and Ag. Stefanos.

At Ag. Stefanos, the lowest volcanic rocks are volcanoclastic conglomerates deposited from channelised hyperconcentrated flows, overlain by an ignimbrite rich in limestone clasts. This is overlain by 50-60 m of marls and clastic sediments, a 10-20 m thick ignimbrite succession, a further 80 m of marls and clastic sediments, and finally 60 m of ignimbrite, possibly in three major eruptive cycles with upward increase in abundance and size of lithic clasts. At Ag. Fokas, 80 m of ignimbrites overlie

thin airfall tuff over marls and are interrupted by two thin intervals of sediment, one marl and the other sandstone. In both localities, interbedded sediments appear to be of fluvial or lacustrine origin.

Paleocurrent indicators in ignimbrites suggest that the Ag. Stefanos section was derived from a source to the southeast and Ag. Fokas from a source to the south, most probably from a Miocene precursor of the modern volcanic centre of Nisyros–Yali. Lithic clasts in the ignimbrites were divided into groups on the basis of petrography and geochemistry, to attempt correlations between Ag. Stefanos and Ag. Fokas and to assess their affinity to the minor andesite-dacite volcanism at Prof. Ilias and Tripa. Preliminary results suggest correlations between the upper Ag. Stefanos ignimbrite and that at Ag. Fokas north. Other ignimbrites appear to be petrographically distinct. Clasts similar to lavas at Prof. Ilias are common in several ignimbrites.

Upper Miocene volcanism was synchronous with emplacement of the Dikeos monzonite during E-W strike-slip faulting. This faulting created local transtensional or transpressional deformation, leading to uplift and unroofing of the monzonite, the overthrusting emplacement of alpine basement onto the monzonite, and creation of the Late Miocene basins in which thick successions of ignimbrite were deposited subaerially or in shallow lakes. The flows at Prof. Ilias and Tripa may be related to the faulted northern margin of a southern Kos basin within which the thick ignimbrites accumulated. The thickest ignimbrites were derived from a stratovolcano located near the present island of Nisyros.

Geology and mineral occurrences of the Faribault Brook area, Cape Breton Island, Nova Scotia

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The Cheticamp area of western Cape Breton Island is located in the Aspy terrane, part of the Ganderia realm of the northern Appalachian orogen. Equivalent parts of Ganderia in Newfoundland and New Brunswick are well known for their mainly volcanic-hosted metallic mineral deposits, and hence the Cheticamp area potentially has similar deposits. Mineral occurrences (Zn, Cu, Pb, Fe, As, Au) around Faribault Brook east of Cheticamp have been exploration targets since the 1890s, and are hosted by rocks generally assigned to the Ordovician-Silurian Jumping Brook Metamorphic Suite (JBMS). Subsequent geochronological work in the 1990s in the area showed that at least some of the metasedimentary and metavolcanic rocks of the JBMS could be Late Neoproterozoic, and similar in age to the ca. 550 Ma Cheticamp Pluton. However, no new mapping or petrological studies had been undertaken since then to assess the significance of these new age data.

During the summer of 2007, an area of ~180 km² that included all of the known mineral occurrences in the Faribault Brook area was mapped at a scale of 1:20 000, and geophysical data were incorporated in constructing a revised geological map of the area. Recent trenches not available to earlier workers were examined, as well as all available drill core from the area in the core storage facility at Stellarton. Mineralization was observed in mafic and felsic metavolcanic units, as well as in associated metasedimentary rocks. Unit names follow as much as possible those established by earlier workers, and include the Faribault Brook metavolcanic unit, Dauphinee Brook schist, Barren Brook schist, George Brook amphibolite, and Corney Brook schist. The Faribault Brook metavolcanic unit is mainly mafic flows with less abundant felsic flows and mafic tuff. The George Brook amphibolite appears to represent higher grade metavolcanic rocks. The Dauphinee Brook schist is fine-grained and pelitic, whereas the Barren Brook schist is coarser grained and has a higher quartz content. The Corney Brook schist is higher grade and includes metasedimentary and meta-igneous units; it may be similar to or part of the Pleasant Bay Complex. The contact between the Dauphinee Brook schist of the Jumping Brook metamorphic suite and the Cheticamp Pluton is intrusive, at least in part, rather than a nonconformity or fault as suggested in some earlier interpretations, based on recently exposed outcrop. Hence at least part of the Jumping Brook Metamorphic Suite is older than ca. 550 Ma. However, felsic porphyry that hosts mineralization at some locations (e.g., Galena Mine) is Silurian based on published U-Pb (zircon) ages. Similar lithology is observed at the Mountain Top Adit where it seems to be extrusive rather than intrusive as at the Galena Mine occurrence.

Barium as a Possible Indicator of Biogenic Methane Generation

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Biogenic gas resources associated with an influx of fresh subglacial water during the late Pleistocene and early Holocene are known to exist in various sedimentary basins in North America. It is suspected that the Western Canada Sedimentary Basin (WCSB) may contain natural gas of this origin but there have not been any detailed studies on this possibility aside from a significant body of research examining the hydrodynamics of the basin during the last glaciation. In this study, the possibility of biogenic gas generation in the Winnipeg Formation is examined through an analysis of groundwater from that formation. The presence of low sulfate and elevated barium concentrations in the Winnipeg Formation of southeastern Manitoba indicates that redox conditions necessary for the production of methane may have been present. Geochemical models created using PHREEQ C corroborate this concept. This indicates that barium might be a good indicator of areas with natural gas potential and this is also supported by data available for the Michigan Basin.

Geological factors affecting surface water chemistry in southwestern Nova Scotia

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In southwestern Nova Scotia, some lakes have been adversely affected by acid rain, causing a reduction of pH and stress to fish habitat. The effects of this acidification have been heavily studied in terms of ecology and water chemistry, and have been extensively monitored and modelled. Previous studies have generally ignored the effects of geology, however, considering the bedrock as 'un-buffering' granites, metasediments and slates. Although bedrock geology may have a more significant control on water chemistry than previously considered, this study focuses on the role of glacial sediment cover on the buffering capacity of lakes in southwestern Nova Scotia.

Southwestern Nova Scotia has been affected by numerous glacial events including the Escuminac Phase, when an ice divide located to the north over the Magdalen Shelf resulted in glacial advance to the south over the region. This phase produced tills and drumlins composed of distally derived material that may have higher calcium carbonate content than locally derived materials. Because of the region's complex history of multiple ice-flow phases, this calcium carbonate is not equally distributed. Understanding its dispersal and relationship to water chemistry is critical for modelling responses to acid rain.

To establish a link between glacial sediment and lake chemistry, the authors compare a Department of Natural Resources archive of over 3000 lake sediment geochemistry samples collected in the late 1970s to water chemistry from Environment Canada's database of monitoring lakes ($n=74$), which has operated continuously since the 1970s. In lakes where both the sediment geochemistry and water chemistry were measured, there is a negative correlation between calcium concentrations in the sediment and the acidity of the water: lakes with higher concentrations of Ca in their sediments have less acidic water. A map of Ca concentrations from the more extensive lake sediment database reveals that lakes with enough Ca in the sediment to buffer the lake pH tend to occur within drumlin fields. This is confirmed at the scale of local catchments, where if the upper topographic elevation is above the occurrence of drumlins a corresponding low Ca concentration is observed. Conversely, in the lower elevations of the catchments, if they lie within a drumlin field, higher Ca concentrations are measured in the sediment.

Ice-flow and deglacial chronology, Foxe Peninsula, southwest Baffin Island, Nunavut

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The Foxe Peninsula lies north of the former Hudson Strait ice stream and along the southern margin of the Foxe Dome of the Laurentide Ice Sheet, placing the peninsula in a salient location to record glaciologically significant events such as marine incursion in Hudson Strait and Foxe Basin. Field data collected in 2006, as part of the Southwest Baffin Integrated Geoscience Project (SWBIG), have led to an improved model of ice flow and deglaciation in the area, based on ice-flow indicators, marine-limit features, distribution of erratics, till geochemistry and radiocarbon dating.

At full glacial conditions, ice flowed toward the east in Hudson Strait. In the eastern portion of the peninsula, ice flow was predominantly to the southwest, flowing from the Amadjuak Ice Divide. The western sector experienced more changes in ice flow, where the potentially full ice configuration flow was toward the southeast, possibly from the Foxe Divide, radiating from the Foxe Dome. Later, flow in the western sector shifted southward, as an apparently greater control was exerted from the Amadjuak Divide.

Ice likely evacuated from the Hudson Strait relatively rapidly, initiating deglaciation of the Foxe Peninsula. This resulted in the highest and oldest glaciomarine features observed on the peninsula: ice contact deltas at 180 m with related radiocarbon ages of *ca.* 8.1 ¹⁴C ka BP (9.0 cal ka BP). As deglaciation progressed, a re-advance formed large moraines (the 'Foxe moraines') on the western part of the peninsula. Elevated calcium in till samples, numerous carbonate erratics, and shell fragments that predate the last glaciation on the peninsula north of the Foxe moraines (i.e. ice proximal side) indicate a source for the material offshore and suggest higher ice sheet velocities and greater transport distances for this phase of ice flow compared to the rest of the study area. An age for this phase is bracketed by radiocarbon ages and marine limit observations distal to the moraine of *ca.* 7.7 ¹⁴C ka BP (8.0 cal ka BP) at 150 m, compared to the age of marine limit proximal to the moraine some 700 years later at 132 m. Between the western and eastern sectors is a lowland area, where the presence of De Geer moraines suggests a grounded ice margin that retreated northwards. This marine incursion may relate to the collapse of the Foxe Dome, disintegration of the Amadjuak Divide, and ultimately formation of the Amadjuak Dome centred over Amadjuak Lake in the eastern sector. This resulted in a shift of ice-flow direction in the north of the eastern sector by more than 90 degrees, to flow to the northwest. In the eastern sector, marine limit elevations decline with more recent deglaciation in a gradual northward pattern with no re-advance detected, and in comparison to the western sector are younger by almost a thousand years.

A Tale of Two Estuaries: Comparison of Anthropogenic Impacts on the Contemporary Evolution of the Avon and Petitcodiac River Systems, Bay of Fundy

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Both the Avon and Petitcodiac River Estuaries have had a long history of modification by human activities ranging from dyking by the Acadians to causeway construction in the late 1960s. This presentation examines the spatial variability and temporal in the intertidal morphodynamics of both estuaries and compares the resilience of each system to the influence of tidal barrier construction. Contemporary bathymetric surveys were compared with historical surveys from the 1960s/70s as well as an 1858 British Admiralty bathymetric chart. These data were modeled and observed changes supported by orthorectified aerial photography and satellite imagery using ArcGIS 9.2.

Both rivers demonstrated very rapid sedimentation during the final stages of the construction and rapid infilling during the first year after the causeway was completed. In the case of the Windsor causeway, this accumulation took place in the vicinity of a pre-existing sand bar. At both sites, there was a significant decrease in intertidal cross sectional area within the first km downstream of the causeway. The greatest decrease was measured on the Petitcodiac (90%) while between a 54 to 75% decrease was measured at Windsor from 1970 to 2006 as a layer of sediment between 5.8 to 6.5 m deep accumulated downstream of the causeway. Once sufficiently consolidated, these mudflats were rapidly colonized by *spartina alterniflora*. Beyond this point, approximately 3 km downstream of the causeway on the Avon River, there was no significant decrease in cross sectional area. The minor changes recorded could not be directly attributed to the causeway, but rather were likely associated with shifts in the main tidal channel as the St. Croix River joined the Avon. In addition, seasonal cycles of changes in bed elevation by as much as 2 m were measured, which exceed differences recorded between 1858-1969 and 2005/2006. For the remaining 11 km downstream, after the entrance of the Kennetcook R., negligible changes in intertidal cross sectional area were recorded since 1858. Any changes in bed elevation can be linked to changes in the position of major intertidal sand bodies. Any areas of sedimentation along the shoreline have been compensated by either deepening of the main tidal channel or bank erosion along the opposite shore. In the Petitcodiac River however, the bed elevation rose by 2 m and continues to infill 16 km downstream of the causeway. It is hypothesized that the resilience of the Avon system to the construction of the causeway is mostly attributed to its sandier sediment and associated sediment dynamics, position of the causeway within the broader estuary and hydrology.

The Halifax Experimental Pollen and Spore Monitoring and Forecast Program: publicizing 6-year results and trends

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The Saint Mary's University-Environment Canada Experimental Pollen and Spore Monitoring Program began operating in Nova Scotia in 2000. Airborne pollen and spore levels have been recorded daily throughout the flowering season at various locations, based on land use and population density. Previously sites have included include Halifax, Beaverbank or Wellington, and Noel Shore (urban, suburban and rural settings, respectively). In 2006 samplers were stationed in Halifax, Kentville, and Sydney, allowing monitoring over greater geographical and climatic ranges. Annual variation in the pollen records appear to be due to biannual reproductive behaviour, local weather conditions, latitudinal differences, and prevailing climatic conditions.

Pollen forecasts are made based on the species trapped, the densities calculated, and the predicted weather. Pollen and spores are potentially allergenic to sensitive individuals, and the forecasts publicize when activity and medication modification may be advisable, helping reduce the demands on the health-care system. Forecasts were updated for Halifax each afternoon Monday to Friday and were available to the public electronically via a hyperlink found at Environment Canada's Halifax weather forecast website. It was also available for Halifax on an automated voice message system.

Long-term monitoring may reveal early indications of vegetation responses and increased health risks from anthropogenic atmospheric contamination and global warming. Seasonal pollen calendar composites can aid in interpreting the taphonomic changes that occur in the processes of deposition and preservation of Holocene pollen records, and the vegetation patterns and climates responsible for producing these records.

LiDAR collection and processing in the coastal Bay of Fundy region and Cobequid-Chedabucto fault system, Nova Scotia.

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Light Detection and Ranging (LIDAR) is a technology that can be used both from an airborne or terrestrial platform to precisely measure range information. Since 2000, researchers at the Applied Geomatics Research Group at COGS have been involved with using airborne LIDAR data to construct high-resolution surface models and more recently using terrestrial based

LIDAR to image cliffed shoreline exposures that are not well resolved with airborne technology. In collaboration with the Geological Survey of Canada, part of the coastal region of the Bay of Fundy has been surveyed with airborne LIDAR, including Joggins and the Parsborro area. Airborne and terrestrial data have been merged to capture the deformation in the Carboniferous rocks along the Walton-Cambridge Cove area. A recent survey has been conducted along the northern boundary of the Cobequid-Chedabucto fault system between Eden and Guysborough. The usual ground point spacing of these small scale surveys are on the order of 0.5 to 1 m and the data volumes are on the order of several gigabytes. Once a survey has been flown the processing steps include: 1. process the trajectory of the aircraft and relate the laser ranges to the aircraft position, 2. export each flightline as binary LAS files (LIDAR standard format), 3. LIDAR point cloud is analyzed to determine ground and non-ground points, 3. points are imported into a GIS for validation and analysis, 4. two types of surface models are constructed: Digital Surface Model (DSM) using all the points and a Digital Elevation Model (DEM) using only the classified ground points. These surface models are then used to derive other parameters such as shaded relief models and surface profiles. Ground points at the top of cliffed shorelines and other abrupt natural vertical structures are often incorrectly classified by most standard algorithms and must be dealt with differently than other variable terrain. This presentation will review airborne and terrestrial LIDAR and the associated workflow and potential pitfalls (abrupt terrain changes) and present examples of recently completed surveys of areas of geoscience interest.

Defining the stratigraphy of the Meguma Supergroup in southern Nova Scotia: where do we go from here?

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In 1998, the Nova Scotia Department of Natural Resources began a major bedrock mapping initiative in the Meguma Group of southern Nova Scotia to produce a series of 1:50 000-scale geological bedrock maps. As a result of mapping, combined with follow-up geological studies, a redefinition of its stratigraphy is now justified.

As previously proposed, the lower metasandstone-dominated Goldenville Formation and upper slate-dominated Halifax Formation should be formally elevated to 'group' status. Mapping has demonstrated that both formations can themselves be subdivided into formations and members. Thus, the Meguma Group will be elevated to a 'supergroup'. The Meguma Supergroup can be divided into two distinct stratigraphic packages separated by the Chebogue Point shear zone (CPSZ). In the Digby-Yarmouth area (west and northwest of the CPSZ), the lower part of the Goldenville Group is the metasandstone-dominated Church Point Formation, whereas the upper part consists of metasilstone of the Bloomfield Formation. Units in the overlying slate-rich Halifax Group are the Acacia Brook Formation and overlying Bear River Formation.

East of the CPSZ in the Pubnico-Chester area the lowest unit in the Goldenville Group is a metasandstone/metasilstone package termed the Moses Lake Formation. The Moses Lake Formation is overlain by the metasandstone-dominated Green Harbour Formation, which is similar in appearance to the Church Point Formation. The middle part of the Goldenville Group consists of metasandstone/metasilstone assigned to the Government Point Formation. No equivalent unit is recognized in the Digby-Yarmouth area. The upper part consists of Mn-rich metasilstone of the Moshers Island Formation. Although this unit appears to be the stratigraphic equivalent to the Bloomfield Formation, no Mn-rich beds have been found west of the CPSZ. Units in the overlying slate-rich Halifax Group include the Cunard and overlying Feltzen formations.

The Church Point Formation of the Goldenville Group contains a metasilstone unit (High Head Member) with a distinctive trace fossil assemblage characteristic of the boundary between the Neoproterozoic and Phanerozoic, suggesting that the Goldenville Group below this member extends into the Neoproterozoic. The upper part of the Government Point Formation has yielded early Middle Cambrian trilobite fossils of Acado-Baltic affinity. The upper part of the Bear River and Feltzen formations locally contains the Early Ordovician graptolite *Rhabdinopora flabelliformis*, suggesting that the underlying Acacia Brook, Cunard, Bloomfield, and Moshers Island formations are Middle to Late Cambrian, and that a significant unconformity exists between the Halifax Group and the overlying late Ordovician - Early Silurian White Rock Formation. A revised minimum thickness for the Meguma Group is 10 km.

One of the most significant obstacles to formalizing the proposed stratigraphy in the Meguma Supergroup is gaining acceptance of the new subdivisions among geologists. Hence, establishment of a joint working group is proposed to reach consensus on the proposed divisions and avoid confusion in the geological literature.

The Quaternary erosional and depositional history of the Black Point area, Saint John, New Brunswick based on seismic sub-bottom profiles

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High-resolution seismic sub-bottom profiles from the region offshore of Saint John Harbour facilitate the first investigation of coastal marine Quaternary units in the area. The data were obtained from a region 7 km W-E, and 10 km N-S encompassing an ocean disposal site located near Black Point in the approaches to Saint John harbour. Sediments dredged from shipping channels in Saint John harbour are disposed of at this site. One sub-bottom profile extends north of the main study area into the mouth of the Saint John River, and another profile extends 21 km south of Partridge Island. A total of 41, mostly N-S oriented lines, were interpreted. The nominal line spacing was 150 m in the central region, and 320 to 750 m in the eastern and western extremities of the study area.

Stratigraphic assignments are based on comparisons with the ground-truthed geological units present off the Scotian Shelf and include bedrock, till, Emerald Silt facies A, Emerald Silt facies B and LaHave Clay. Some differences were noted from the Scotian Shelf region including the presence of a single layer of non-interdigitating till, which becomes discontinuous to the north. Several sedimentary packages restricted to the northern region of the study area are related to the local outflow of the Saint John River or local seabed currents (e.g., the Mispic dune field). To the north, the LaHave Clay also appears to undergo a facies change, as more typical laminar bedding is replaced by cross-bedded units, which may reflect higher near-shore currents, or the influence of the Saint John River.

Several areally-extensive unconformities are defined, revealed by reflector truncation, including two within the Emerald Silt facies B unit, and one at the base of the LaHave Clay. The Mispic dune field, in the east of the study area, lies unconformably on older units. South of the dune field, the seafloor appears to have changed from being predominantly depositional during glacial times to one which is now dominated by erosion. Recent erosion has exposed Emerald Silt facies B on the seabed.

Lower Silurian subduction-related volcanic rocks in the Chaleurs Group, northern New Brunswick, Canada

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Volcanic rocks are hosted by Lower Silurian rocks of the Chaleurs Group at two locations in northern New Brunswick. At Quinn Point, minor mafic to intermediate volcanic rocks occur in the Weir Formation, and at Pointe Rochette, a thin bed of felsic tuff has been identified at the top of the Clemville Formation. These rocks are interpreted as the first evidence in New Brunswick of magmatism associated with Late Ordovician-Silurian northwest-directed subduction of the Tetagouche-Exploits back-arc basin. At Quinn Point, volcanic rocks include a thick flow of massive basalt, and mainly andesitic cobbles and boulders in overlying conglomerate beds. The basalts have low (evolved) Mg#s, despite high Cr and Ni values and abundant pseudomorphed olivine phenocrysts, implying replacement of Mg by Ca during olivine alteration. The *in situ* flow and the conglomerate clasts are chemically alike, and display volcanic-arc affinities on diagrams used to infer tectonic setting. The volcanic rocks were emplaced in the fore-arc region, probably reflecting local step-back of the magmatic axis due to accretion of continental back-arc ribbons. Chemical characteristics such as depleted HREE, high La/Yb, high Al₂O₃ and slight positive Eu anomalies suggest that the parent magma may have been generated from partial melting of the subducting slab, namely young, warm Tetagouche-Exploits back-arc oceanic crust. Subduction of young back-arc crust in general was probably largely responsible for the relatively low volume of Early Silurian arc magmatic rocks in the northern Appalachians. At Pointe Rochette, fine-grained vitroclastic felsic tuff has a rhyodacitic composition and displays extensive alkali and large-ion-lithophile mobility, with depletion in K, Rb, Ba and Cs. Elevated Th and U, and depleted high-field-strength elements (Nb, Hf, Zr), are consistent with a subduction-influenced setting, although REE abundances are low and the REE profile is relatively flat and unfractionated. A U-Pb (zircon) age of 429.2 ± 0.5 Ma was obtained from the tuff, consistent with the late Llandovery to early Wenlock fossil-indicated age of the overlying La Vieille Formation. Although not altered to bentonite, the age of the tuff suggests an affiliation with one of many Early Silurian subduction-related K-bentonites documented in northwestern Europe and eastern North America, e.g., at Arisaig in Nova Scotia.

Distinguishing between geogenic and anthropogenic sources of arsenic in soils in the North Brookfield Gold District, Nova Scotia

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Soils in the North Brookfield Gold District, Nova Scotia are enriched in arsenic (As) both naturally, associated with local gold mineralization in bedrock, and anthropogenically, due to the processing of gold ore. The focus of this research is on soils surrounding the abandoned, publicly-accessible North Brookfield Gold Mine which operated from 1887-1936, and produced approximately 43,000 troy ounces of gold from 105,000 tonnes of crushed rock. At present, the North Brookfield district is a popular recreational site with off-road vehicle enthusiasts, who have constructed ramps and jumps using the historical mine tailings. North Brookfield is a unique site because it is the only Nova Scotia Gold mine that, in the early years of operation (from 1897 to 1903), combined roasting and chlorination in the extraction of gold from the arsenopyrite (FeAsS)-bearing ore. Roasting of the gold ore decomposed the arsenopyrite to iron oxides, releasing sulphur dioxide (SO₂) and arsenic trioxide (As₂O₃) from the stacks to the surrounding area. Arsenic trioxide is a very soluble and potentially mobile form of arsenic and understanding its fate in the environment is important for assessing the potential risks associated with human exposure to these soils. In 2007, 10 shallow soil cores (40-60 cm long) were taken with the objective of developing and applying methods of distinguishing between geogenic and anthropogenic sources of As in North Brookfield soils. Samples were taken within 1 km upwind and downwind of the approximate location of the historic roasting stacks. Results from bulk aqua-regia soil digestions and ICP-AES analysis show that the average As concentrations for all sub-samples was 300 ppm (median= 38ppm), exceeding the Canadian Soil Quality Guideline of 12 ppm (residential and parkland soils). Five sub-samples from two locations stand out, with As concentrations in the top 10 cm ranging from 350 to 4300 ppm. These samples were taken within 100 m of the

furnaces and chlorination house. The high As sub-samples were magnetically separated, then magnetic materials and residuals were made into thin sections. Roaster-derived Fe-oxides, natural Fe-Ti oxides and primary sulphides were identified in the sections, along with an as yet unidentified brown mass. Synchrotron-based microanalytical techniques were then used to identify nano-crystalline As-bearing phases and results indicated that As was associated with all of the above phases. Preliminary examination of XANES (X-ray absorption near-edge spectroscopy) data shows that the As was predominately As⁵⁺ with typically 10 % As³⁺, however one sample of the weakly reflective brown mass had significant As³⁺. Work to-date suggests that anthropogenically derived As is associated with the brown mass, while natural As-bearing materials such as the weathering products of arsenopyrite were also observed. Future work on soils from the area will include sequential selective extractions on high-As samples, as well as scanning electron microscopy and electron microprobe analysis.

Petrology and tectonic significance of coronitic mafic granulites, Southampton Island, Nunavut

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Southampton Island, south-central Nunavut, occupies the "Dorset corridor", the enigmatic boundary region between the Trans-Hudson Orogen and the western Churchill Province. The eastern part of the island is underlain largely by granulite and upper amphibolite facies metagranitoid rocks, with local supracrustal enclaves. Mineral assemblages, textures, and P-T estimates in mafic enclaves from the eastern part of the island shed light on first-order aspects of the regional tectonometamorphic history. Most samples contain the granulite facies assemblage grt-opx-cpx-plag-hbl, with spectacular coronitic textures developed around garnet porphyroblasts. Three suites of texturally heterogeneous granulites each preserve three textural domains, interpreted to represent three points on the P-T path. Near-peak metamorphic conditions, 850-900 °C and 0.9-1.0 GPa, are preserved by cpx-opx-plag inclusions in garnet. Symplectites of opx-plag-spl-mag around garnets indicate near-isothermal decompression from 0.8 to 0.7 GPa at 800-850 °C. Matrix plg-cpx-opx-hbl represents a re-equilibrated assemblage, yielding a P-T estimate at 500-600 °C and 0.5-0.6 GPa. The P-T path derived from these estimates contrasts with those obtained from lithologically similar units in the western Churchill Province, suggesting that the rocks of Southampton Island share tectonic affinities with the Baffin-Ungava segment of the Trans-Hudson Orogen.

Geochemistry of the Bauxitic-Lateritic Occurrences in the Deh-Dasht area, Zagros, Iran: Exploration Guidelines

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This study is focused on the bauxitic-lateritic paleo-horizons in the Deh-Dasht area 250 km east of Ahvaz city, Iran, located within the Zagros fold belt. The bauxite horizon developed on strata of the Cretaceous Sarvak and Ilam Formations. Most occurrences are related to the exposure of the paleo-horizons in the eroded limbs and cores of major anticlines, and have a predominantly NW-SE elongation, parallel to the main structural trend of the Zagros. The age of folding and faulting is Oligocene-Miocene, which were followed by erosion, exposing the bauxite horizon.

Boehmite, Gibbsite and Diaspore are the main Al-bearing minerals in the Zagros bauxitic paleo-horizon. The bauxitic stratum in the study area can be divided into three main parts: 1) Argillite- argillaceous bauxite (Lower layer), 2) Bauxite zone (e.g., red and white bauxite; Middle layer) and 3) Ferruginous Limestone (Upper layer). Geochemically, the Zagros bauxitic horizon contains mainly Al₂O₃ (19 - 62 wt. %), Fe₂O₃ (3 - 38wt. %), SiO₂ (10 - 35 wt. %) and TiO₂ (0.28 - 3 wt. %). In general, Ti, Al, and the trace elements V, Cr, Zr, Nb, Y, and Th get enriched through all parts of the bauxite sequences with respect to the unweathered protolith. The highest value of Ba and Sr are observed in the Sarvak Formation's bauxitic limestones and marly limestones. The high values of Ca, Mg and Si in some yellow bauxite and red bauxite samples can be explained by the presence of kaolinite in the bauxite. The enrichment of V, LREE, Th, Nb, Co, Cr, Ni and Zr is interpreted to reflect the concentration of these elements in the Fe oxides and Ti-bearing minerals.

Geological and structural investigations in combination with remote sensing techniques are found to be useful in exploration of new bauxite-bearing districts in the Zagros. The Crosta technique, a multivariate statistical technique that uses multi-spectral image channel data, has been used in this project to help in the discrimination of economic bauxitic-lateritic occurrences. Ground truthing reveals that the bauxitic-lateritic occurrences outlined by the Crosta technique coincide well with the studied areas and the favorable geochemical characteristics determined. Detailed geology and estimation of ore reserve of these occurrences require a systematic sampling and drilling program.

Mineralogy of a lead-barite occurrence in Kap Henson, Northumberland Island, Greenland

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During a traverse part of the Canadian-German Nares Strait Geocruise 2001 expedition, we came across "vuggy" diabase, a cavity ridden upper part of a regionally extensive diabase sill, with irregular cavities (1-20 cm) and irregular veins (0.5 to 10 cm) partially filled with calcite, barite, minor quartz and sulphides, mainly galena, in crystals up to 2 cm. The locality is at Lat. 77° 22.087' N/Long. 71° 30.568', at 265 m.a.s.l. in Kap Henson of deserted Northumberland Island. The altered and sparsely mineralized rock is exposed in an area of 250 m in an E-W direction, by 35 m NS. Alteration has corroded the phaneritic quartz

diorite, and locally the rock is intensely altered and can be dug out with a knife. The permeability for the veining was provided by extensional fractures and the upper contact of the brittle (Proterozoic) sill with grey shales of the (Proterozoic) Dundas Group. Transmitted and reflected light microscopy and electron probe microanalysis indicate that the host rock is a fine grained quartz diabase with pyroxene, amphibole, biotite, plagioclase (sericitized), K-feldspar and minor quartz. Magmatic titanomagnetite is very abundant and pyrite and chalcopyrite occur in accessory amounts; euhedral apatite is conspicuous as relatively large inclusions within the major minerals. The rock is affected to various degrees by alteration dominated by sericitization and chloritization. The main hypogene vein sulphide is galena, with lesser amounts of chalcopyrite, and minor pyrite and rare sphalerite. Calcite and barite (one earlier generation clear, euhedral; one later cloudy, brownish) and minor quartz are the gangue minerals, and the veins are crustified, having formed by open-space filling. Quartz occurs as doubly terminated bipyramids in calcite and barite (early), and in granular veinlets (late). All barite is rich in two-phase (liquid-gas) fluid inclusions, and barite II contains traces of solidified petroleum. Two-phase fluid inclusions homogenize (median T_h) as a liquid at 158 °C (calcite) and 165 °C (barite) respectively. There is no evidence of boiling of the fluids. Ice-melting temperatures ($T_{m,ice}$) of -35 °C (calcite) and 0 °C (barite) suggest the involvement of two distinct fluids, one Na-Ca-Mg, probably basinal brines, and the other dilute meteoric water. Hydrocarbons may have played a chemical role in sulphide precipitation. Hydrothermal alteration has produced calcite, epidote and chlorite. Incipient weathering has produced covellite, chalcocite, goethite and trace malachite as alteration products of chalcopyrite and/or pyrite. The age of mineralization is clearly post-Proterozoic intrusion and post brittle fracturing. Apatite fission track data indicate that the rocks now at the surface at Kap Henson cooled below ca. 100 °C in the Triassic, hence the age of base metal deposition is constrained between post-Proterozoic and Triassic. Hot basinal fluids, as well as penetrating meteoric fluids were involved; hence it is possible that mineralization took place during basin inversion.

THE ATLANTIC GEOSCIENCE SOCIETY (updated December 2007)

The Atlantic Geoscience Society (AGS) exists to promote a better and wider understanding of the geology of Atlantic Canada, both to its members and to the public. Membership is open to anyone interested and includes professional geologists and geophysicists, students, prospectors, and lay people. For 2007-2008, the Society has about 200 members drawn primarily from Nova Scotia and New Brunswick, but including some from other provinces. To encourage active participation, membership fees are kept at a reasonable figure (\$10.00, \$5.00 for students) and each year the annual meeting is moved to a different venue.

History *by Graham Williams*

It is hard to believe that in 1971 there was no regional society interested in or focused on the geology of the Maritime Provinces. To rectify this, a letter was circulated to geologists and geophysicists of the three provinces (New Brunswick, Nova Scotia and Prince Edward Island), asking for an expression of interest. The encouraging response led to an evening meeting in Halifax, October 1971, to discuss the viability of a regional group. Several long-standing members of the community favoured starting a Section of the Geological Association of Canada, but others proposed the founding of a new and independent Society. A questionnaire mailed to all interested parties showed overwhelming support for an independent group, with the most acceptable name (by one vote) being the Atlantic Geoscience Society.

The Atlantic Geoscience Society came into existence on 11th April 1972, at a meeting held at the Bedford Institute of Oceanography, Dartmouth. About 30 members including representatives from the federal and provincial geological surveys, the regional universities, and industry attended the natal day ceremonies. The first general meeting was held 31st May, in the Faculty Club of Dalhousie University. Don Sherwin of the Federal Government gave a talk on the geology and petroleum potential of offshore eastern Canada, a topic which would not be out of place today.

At the 31st May meeting it was decided to hold monthly meetings throughout the fall, winter and spring months, with presentations by invited speakers and to publish a regular newsletter. It was also decided to make the first evening meeting in the fall, usually in September, the Annual Meeting, with election of officers. And to encourage membership, the annual dues were set at one dollar, a cost which was not increased for five years. At the September meeting, Rupert MacNeill of Acadia University was officially installed as the first president.

Recognition of the importance of the Atlantic Geoscience Society first occurred on October 1973. At the Geological Association of Canada's Council Meeting in Kingston, AGS officially became an Affiliated or Associated Society of GAC. In the following January, AGS consolidated its position by holding its first Colloquium, "The Geological Evolution of the Atlantic Seaboard of Canada", in Fredericton (19-20 January). Despite taking place in the middle of a major snow storm, his very successful two day meeting attracted over 150 people, from the Maritime Provinces, Newfoundland and Ontario.

The response to the Fredericton meeting led to the organizing of the second Colloquium, "Natural Resources of Atlantic Canada", held at Acadia University, Wolfville, in January 1976. Again, despite the inclement weather, there was an excellent turnout with about 200 in attendance. By great good fortune, the Society had hit on a time of year when it had a captive audience, since where else can one interested in the geosciences go at this time of year in the Maritimes. Coupled with the enthusiastic response was an increase in membership to about 175.

1976 was a particularly good year for the Atlantic Geoscience Society since the Geological and Mineralogical Associations of Canada accepted the Society's offer to hold their 1980 Annual Meeting in Halifax. The chairperson of the Steering Committee for this meeting called Halifax '80 was John Smith, Deputy Minister of Mines for Nova Scotia. And, AGS held its second major meeting of the year on Saturday, 11th December, at Mount Allison University. The one day Colloquium, "Current Research in the Maritimes", attracted over 70 participants, with 44 speakers. The registration, in keeping with AGS policy, was \$2.00.

The only year since 1976 that the Society has not held a Colloquium or Symposium was in 1977. The Society was not resting on its laurels, however, since it initiated a project to produce a geological highway map of the Atlantic or Maritime Provinces, primarily intended for the general public but also to be finished in time for the Halifax '80 meeting. Another milestone occurred on Thursday, 13th October, when AGS hosted an executive meeting of the Canadian Geoscience Council, the umbrella organization for all Canadian geoscientific societies.

In 1978, AGS renewed its annual meetings with a major symposium 20-21 January in Fredericton, where 140 gathered to discuss "Provincialism". At the accompanying banquet, the Society started the practice of inviting the president of either the Geological Association of Canada or the Canadian Society of Petroleum Geologists to be guest speaker. This practice was allowed to lapse in 2002. The year was also marked by the decision to produce a geological highway map, but to cover only Nova Scotia initially.

A draft version of the Nova Scotia geological highway map was displayed at the 1979 Biennial Colloquium, "Current Research in the Atlantic Provinces", on 19-20th January in Amherst. The map was developed jointly with the Nova Scotia Department of Mines and Energy and the Nova Scotia Museum. It marked the first of several endeavours that AGS undertook in partnership with other organizations. In the fall, AGS helped organize a fun day for children at the Nova Scotia Museum, where one of the most popular activities was panning for gold. The festivities were part of Logan Day celebrations, a day named in honour of the first Director of the Geological Survey of Canada. Activities took place across Canada, from St John's to Victoria.

Halifax '80, the Annual Meeting of the Geological and Mineralogical Associations of Canada, 19-21 May, was the most important function of the AGS in its first decade. Over 1100 people attended this enormously successful gathering. There were several highlights, one of which had to be the official publication of "The Geological Highway Map of Nova Scotia". This superb production is not simply a map. It also tells the story of the geological history of the province; numbers and describes 92 sites and highlights eight key areas, such as Joggins. The map has been a major success, a revised version being published in 1990 and a repackaged version in 1994. A third edition was published in 2005.

On 28th September 1980, the AGS again celebrated Logan Day, now christened National Geoscience Day, by hosting "A Day of Geology" at the Nova Scotia Museum. The main objective was to inform the public, especially children, about geology through demonstrations of rocks and minerals, fossils, films, gem polishing and contests. The highlight was a field trip to a once famous gold producing area.

The 80s were times of major accomplishments for the Atlantic Geoscience Society. One of the first was the Earth Science Teachers' Workshop, 5-7 November 1982. This Workshop, held at Bedford Institute in Dartmouth, focused on the coastal and offshore geology of eastern Canada and informed the teachers of some of the latest developments. It was one of the first focused outreach activities of the Society.

The response to the Nova Scotia Geological Highway Map motivated the decision in 1983 to produce one for New Brunswick and Prince Edward Island. Another factor was the decision by the Society to throw its support behind the Department of Geology of UNB., which was organizing the 1985 Annual Meeting of the Geological and Mineralogical Societies of Canada, to be held in Fredericton. At about the same time, Phil Hill proposed that AGS produce a series of videos under the title "The Geology of Atlantic Canada". The idea was to produce educational videos for use in high schools and of interest to the general public.

1984 was memorable, not only because of George Orwell, but because at the AGS Annual Meeting in Amherst, 20-21 January, the Rupert MacNeill award for best student paper was presented for the first time. The winner was Allan Huard, who gave an excellent talk on the Carboniferous Fisset Brook Formation.

A milestone at the 1985 Annual Meeting in Wolfville, 18-19th January, was the premier viewing of the promotional rock video. The video was produced to generate funding for the Society's proposed video series. The four videos to be produced were: "The Mineral Wealth of Atlantic Canada", "The Appalachian Story", "Offshore Oil and Natural Gas", and "The Recent Ice Age". During the year, the Atlantic Geoscience Society became an Affiliated Society of the Canadian Society of Petroleum Society. This was the stamp of approval for an ongoing informal liaison that over the years had proved extremely fruitful.

The 1985 Annual Meeting in Fredericton of the Geological and Mineralogical Associations of Canada went off without a hitch, as did the launching of the New Brunswick and Prince Edward Island Geological Highway Map: the latter was produced through the generosity of the New Brunswick Department of Natural Resources. One major breakthrough was the publication of both French language and English language editions.

Following the tragic deaths of two young geologists, crushed when a ditch collapsed in 1984, the AGS organized an evening seminar and panel discussion for 25th September 1985. The topic, "Occupational Safety in the Geosciences", was a timely reminder of the risks inherent in geological field work and in mining.

As an informally run Society, AGS has compiled an impressive record. On 9th April 1986, AGS became the proud parent of its own journal "Maritime Sediments and Atlantic Geology", subsequently shortened to "Atlantic Geology". This is the only regional geology journal in Canada and has a history of continuing production dating back to 1965, when Bernie Pelletier started publishing "Maritime Sediments". In 1986, the Society hosted the Basins Symposium, "Basins of Eastern Canada and Worldwide Analogues", held in Halifax, 13-15 August. Cosponsors were the Canadian Society of Petroleum Geologists and the Inter-Union Commission on the Lithosphere. Registrants came from all over the world for the intensive technical sessions and excellent social program. One impressive offshoot of this Symposium was the CSPG Memoir 12-AGS Special Publication 5, "Sedimentary Basins and Basin-Forming Mechanisms", published in 1987. This 527 page compendium quickly became a classic.

The 1987 Annual Meeting, held in Fredericton, 6-7 February, featured the introduction of workshops. The two workshops were "Metamorphism in Basic-Ultrabasic Complexes", and, "Maturation Studies and Petroleum Geology". The response to these guaranteed the continuing presence of workshops on the program for all future Annual Meetings.

While the above major developments were taking place, production of the first video in the Geology of Atlantic Canada series began under the direction of Bill Skerrett. The video, "The Mineral Wealth of Atlantic Canada" was released 16th September 1987, when it was shown at a Society evening meeting. In 1986, a major oil company had provided funding for a second video, "The Appalachian Story". The premier of this production was at the AGS Symposium in Antigonish, 6th February 1988.

The educational value of the first two videos provided impetus for the production of the remaining two. "The Recent Ice Age" premiered Wednesday, 11th April 1990 at the Archives of Nova Scotia to a select audience. "Offshore Oil and Gas" had a more impressive send off at the World Trade and Convention Centre in Halifax, Wednesday, 4th November 1992. This, the last in the series, also featured Jay Ingram as narrator.

It was quickly realized that the impact of the video series could be enhanced by production of video guides for teachers, so plans were set in motion to write and publish these as quickly as possible. The three published are "The Appalachian Story", "The Recent Ice Age", and "Offshore Oil and Natural Gas".

The videos have reached a wide audience, duplication rights being sold to many Departments of Education, including the Provinces of Nova Scotia, Newfoundland, New Brunswick and British Columbia. There have also been a surprising number of

sales to university departments throughout North America, several regional school boards, and libraries. The video guides have also developed a loyal following.

Not having learned from past experience how traumatic it was, AGS Council agreed in 1987 to host the 1992 Annual Meeting of the Geological and Mineralogical Associations of Canada, to be held in Wolfville, 25-27 May 1992. As with Halifax '80 and Fredericton '85, Wolfville '92 was an impressive meeting. It differed, however, in having a strong outreach program, including a teachers' workshop with accompanying field trip.

Bringing the 1980s to a close was the first presentation of the AGS Distinguished Service Award. The recipient, Laing Ferguson, received the honour at the 1989 Annual Colloquium, 3-4th February, fittingly held in Amherst.

The retrenchment in the economy in the late 80s and early 90s had a major impact on the Atlantic Geoscience Society. Memberships lapsed and attendance at the Annual Meetings declined but there always remained a committed cadre. This was demonstrated at the 1993 Annual Meeting in Halifax, 12-13 February, when about 175 registrants braved a fierce storm (rain surprisingly) to attend. A notable event at this meeting was the awarding of the Gesner Medal to Les Fyffe, the first recipient. The Medal, designed by Gordon Fader, is awarded to a person who has, through his or her own efforts, developed and promoted the advancement of geoscience in the Atlantic Region in any field of geology, and whose contributions are of such significance that they have made an impact outside our area.

A milestone in the nineties was the official recognition of the Society's outreach program, by formation of the Education Committee. During its existence, this Committee has fostered several new initiatives, including bringing the EdGEO teachers workshops to Nova Scotia. EdGEO is a committee of interested Canadian geologists, which organizes Workshops for elementary and high school teachers in most of the provinces. Funding for these Workshops is provided by the geological community, primarily the Canadian Geoscience Council and its member societies. The first Nova Scotia EdGEO Workshop, "The Earth Sciences: New Resources for Teachers", was held in Halifax-Dartmouth, 22-23 August 1994. The format adopted and maintained for several Workshops, was a Monday morning classroom session, Monday afternoon field trip, Monday evening banquet and talk, and Tuesday morning classroom session, concluding with a summation. The teachers' reactions to the Workshop were surprising. They were enthusiastic; especially about some of the resource material handed out, and liked the two day format. However, the neglect of earth science in the curriculum was reflected by several requests to run a workshop, "Introduction to Geology". Other suggestions were for more field trips and for field trip guides.

The response to the first Teachers Workshops led to the decision to make it an annual event but to move location, so that teachers from other parts of the province could attend and each field trip would be different. Subsequently, Workshops have been held in Sydney (1995), Wolfville (1996), Bridgewater (1997), Truro (1998), Parrsboro (1999), Antigonish (2000), Parrsboro (2001), Digby (2002), Parrsboro (2003), Dartmouth (2004), Halifax and Parrsboro (2005), Dartmouth (2006) and Wolfville (2007). The presenters at the fifteen EdGEO Workshops have all been geologists, who volunteered their time because they believe that they can help to make teaching earth science a lot more fun. And the support of others, in helping with the logistics, has been tremendous.

1996 marked the introduction of field trips to the Annual Colloquium as AGS held its first meeting in Bathurst, New Brunswick. Twenty five people took part in a tour of the Brunswick No. 12 Mine. Many of the 180 registrants enjoyed taking the train to avoid a long drive. A workshop on Exploration Geophysics was also held.

In 1997, the Atlantic Geoscience Society celebrated its Silver Jubilee at the Annual Meeting in Amherst, Nova Scotia, on 7-8 February 1997. One of the highlights was initiation of the Graham Williams Award for Best Poster Presentation by a student. The first recipient was Sandra Marshall of Acadia University. It also marked the introduction of the Noranda Award, initiated by Dave Gower of Noranda Mining Inc., for the best Economic Geology presentation by a student. Kelly Janssens from UNB was the first winner.

1998 marked the publication of "Discovering Rocks, Minerals and Fossils in Atlantic Canada", a superb guide to some of the best geological sites in Newfoundland, New Brunswick, Nova Scotia and Prince Edward Island. The impact of this publication is reflected in the sales, and the speed at which the first printing sold out. This is not surprising since it is of interest to professional geologists, teachers, students and the general public.

The birth of the AGS-Photographic Guild of Nova Scotia Geology and Photography Competition occurred in 2000. Each year, the winning photograph is selected from several entries submitted by members of the Photographic Guild. To encourage participation, AGS organizes an annual field trip, which usually attracts about 20 photographers, to one of the classic geological sites in Nova Scotia. Venues have included Five Islands (2002), Joggins (2003) and East Bay and Wasson Bluff (2004), Five Islands (2005) and Blue Beach (2006). There was no field trip in 2007. A second trophy, The Last Billion Years Award, was introduced in 2005. The winner must be a photograph of somewhere in the Maritime Provinces. The photographs chosen as the winners are available to AGS for use in publications and in displays.

A new look in outreach products was first mooted at the 1995 Annual Meeting in Antigonish, Nova Scotia. There, it was proposed that there should be a popular book on the geology of the Maritime Provinces, written so that high school students or lay people would find it interesting and informative. This developed into "The Last Billion Years: a Geological History of the Maritime Provinces of Canada", which is a 212 page volume. The book is beautifully illustrated, with some original water-colour paintings, photographs, line drawings, dioramas, schematics and geological maps, most in full colour. Production of "The Last Billion Years" has truly been a regional endeavour, with contributions from the Geological Survey of Canada, Nova Scotia Department of Natural Resources, New Brunswick Department of Natural Resources, Canada-Nova Scotia Offshore Petroleum Board and most regional universities.

“The Last Billion Years”, co-published by the Society and Nimbus Publishing, became available for purchase on 10th July 2001. The first print run was for 2100 copies. The success of the book was confirmed when it became out of print in five weeks. After discussions with Nimbus, it was agreed to reprint 2000 copies. The reprinted version was released in early November (5th). This was sold out in January 2002, necessitating a third printing of 3000 in February 2002, with a fourth printing of 2000 in 2003. At the end of 2007, sales stood at about 8000.

In 2003, AGS held its first joint meeting with the Northeastern Section of the Geological Society of America. This was held 27th-29th March in the Westin Hotel, Halifax. The attendance was impressive, with over 650 geologists and friends from various parts of Canada and the USA braving the unpredictable “spring” weather. One of the most popular events was the education session, “Communicating the Relevance of Earth Science”, held on the Saturday. At this, many of the talks were hands-on demonstrations, a great hit with the 42 teachers and several geologists who attended.

The AGS poster, “The Evolving Maritimes” was on sale for the first time at the above meeting. The centre-piece of the poster is the cover painting from “The Last Billion Years”. The comprehensive text describes, in English and French, the evolution of the Earth and of our region’s animals and plants over time.

A disappointment of recent years was the demise of the AGS evening talk series. These were held, primarily in Halifax, for about twenty years but as time passed the audience became too few to justify continuing. Several Society members banded together in 2001 and decided to try again but with a different slant. The first year, 2001-2002, featured speakers who had authored chapters in the book “The Last Billion Years”. Talks were aimed at a general audience rather than focusing on a specialized topic. And the series would be a joint production of the Nova Scotia Museum of Natural Science and the Society, with the talks held on the third Wednesday evening of each month at the Museum.

The series, “The Last Billion Years” opened in September 2001. Because of its success, the series was reborn in 2002-2003 as “Beyond the Last Billion Years” and has continued to thrive. The talks draw spectacular turnouts, with crowds averaging over 100 for the second season. The third season had one or two bumps resulting from hurricane Juan but proved just as popular. For 2004, there was a new slant. Complimentary copies of the poster, “The Evolving Maritimes” were handed out to draw winners at the beginning of each talk. Another slant was the awarding of copies of “The Last Billion Years” to those who attended all the talks in the 2003-2004 year. This was continued in 2004-2005 and 2005-2006. But it was discontinued in 2007, when the talk series moved to Bedford Institute for a year. The biggest surprise is that very few geologists attend the talks, but we are hoping to change this in future years. Obviously, the Museum and Society are filling a need to attract such impressive numbers.

In 2004, AGS published “Nova Scotia Rocks”. This brochure includes over 40 stunning photographs of geological highlights, with a brief accompanying write-up. The photographs are attractively displayed around a geological map of the province on which the sites are pinpointed. Museums and companies with a geological bent are featured on the obverse side of the brochure, with a highway map showing location of the operation according to the provincial trail. Thirty seven thousand copies of the brochure were printed, thanks to generous funding from the Nova Scotia Department of Tourism, Culture and Heritage. In July 2004, the Department mailed 10,000 copies to individual tourist offices for free distribution. Apparently, the brochures are proving very popular, selling (a play on words) out several times at the Halifax Airport location.

Producing such publications as “The Last Billion Years” and “Nova Scotia Rocks” has given the Education Committee an added appreciation of the importance of visuals, whether paintings, photographs or schematics. This awareness has played a major role in the Fundy Basin Poster project, which started in 2003. One of the products was a series of water colours by Judi Pennanen, the artist who did 15 paintings for “The Last Billion Years”. The five water colours show landscapes in Wolfville, Blomidon, North Mountain Basalt, and McCoy Brook times, plus a spectacular scene starring prosauropods. Visually, all five are stunning. The intent is to use the paintings, which are on display at the Fundy Geological Museum, as the focus of a booklet on the Mesozoic history of the Fundy Basin.

The Society had four important milestones in 2005. The first was organizing Halifax 2005, a 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 Science. Although the weather was not too cooperative, the meeting was highly successful, judging by the impressive turnout, the excellent technical and field trip programs, and the entertaining social events.

Publication of the third edition of the Nova Scotia Geological Highway Map was the second significant accomplishment in 2005. The map has been considerably enhanced with upgraded graphics, resulting in an aesthetically pleasing product. Sales have been as impressive as the previous two editions.

The first New Brunswick EdGEO teachers’ workshop was a third milestone in 2005, organized by Dave Lentz and the New Brunswick EdGEO branch.

A fourth milestone with potentially major implications was acceptance as a participant in CRYSTAL. This research program, under the leadership of the University of New Brunswick’s Department of Education, was to evaluate the success in teaching science in schools throughout the Maritime Provinces. One of the evaluations will be focused on the achievements of outreach programs, such as the EdGEO Workshops and the various other products that AGS has produced. The National Science and Engineering Research Council, which is funding CRYSTAL, will provide one million dollars over five years.

An important accomplishment of the Society has been the development of EarthNet (<http://www.earthnet-geonet.ca/>). EarthNet is a database of earth science resources that are useful to elementary and high school teachers. Other features are: “Classroom Activities” which teachers can download at no cost; an illustrated “Glossary of Terms”, a “Calendar of Events” that informs users of events in their part of Canada; “Geology in the Classroom”, a Q & A section where previously answered questions are also posted; “Earth Science Site of the Week” where a new science site is featured every week, “Exploring the

Dynamic Earth”, where animation and video will supplement illustrations photographs and text and the Virtual Field Trip, which takes you to one of the spectacular sections in Nova Scotia (and eventually throughout Canada). The project, initiated by AGS was adopted as a project by the Canadian Geoscience Education Network, the premier organization of geologists devoted to advancing outreach activities in Canada. EarthNet has also been supported by the Geological Survey of Canada.

EarthNet was revitalized in 2004, through a renewed interest by the Geological Survey of Canada in updating the site. This rising from the ashes included the formation of a National EarthNet Committee and a Development Committee. The latter operates out of GSC (Atlantic) and includes a high proportion of AGS members. The database has been redesigned and updated with some major improvements, especially in the Glossary, The Virtual Field Trip, and the Resources sections. Son of EarthNet, the revised version, was released in 2005.

After the very (financially) successful Halifax 2005 meeting, the host society's share of the profits materialized in the bank in 2006, and the first third was promptly allocated to the major task of digitizing the entire run of *Atlantic Geology*. The last printed edition of the journal was volume 42 - all subsequent issues have been electronic.

In April 2006 after a hiatus of over 15 years, the video committee released another video “Halifax Harbour: A Geological Journey”. The video tells the story of this famous harbour, from formation of the Meguma Group to the present day, and looks into the future with predictions on sea-level rise. The video was produced by Charlie Doucet of MoonGlow Digital Video Productions Ltd., the scientific director was Gordon Fader, and narration is by George Jordan.

As society changes, the Atlantic Geoscience Society has to adjust. Its primary mandate remains the dissemination of geoscientific knowledge and information, primarily through the Annual Meetings where there are usually more than 50 oral and poster presentations, and its research journal, *Atlantic Geology*. However, there is an increasing awareness of the importance of outreach activities and the need to play a role in the education of elementary and high school students, teachers and the general public. Based on its past accomplishments and present goals, the Atlantic Geoscience Society will continue to play a vital role in the dissemination of earth science knowledge in the Maritime Provinces, whether at the professional or lay person's level. That is not a bad record for a group of volunteers, largely funded by the geological community.

Mission Statement

The objectives of the Atlantic Geoscience Society are to: further the dissemination of earth science research in the geological community of Atlantic Canada; organize symposia, colloquia, workshops, field trips, and annual and evening meetings, focused on research in the earth sciences in Atlantic Canada; publish the journal “*Atlantic Geology*”, to foster communication within the earth sciences; publish Special Papers on selected topics of interest, as and when needed; encourage the interchange of geoscientific data between government, academia and industry; develop outreach programs to promote an interest in and understanding of the earth sciences; run workshops for elementary and high school teachers to facilitate the teaching of earth science in the Maritime Provinces; periodically publish outreach material, books, maps, tapes, DVDs or websites.

Plans

The Atlantic Geoscience Society intends to: continue holding Annual Meetings at different towns and cities in the Maritimes, with the focus on selected research topics in the earth sciences; run evening meetings as and when required; publish three issues of *Atlantic Geology* each year; promote and develop outreach programs; provide funding on an ad hoc basis for selected research and outreach programs; publish special papers; continue the EdGEO workshop program; continue upgrading EarthNet; and be an annual exhibitor at the Nova Scotia Gem and Mineral Show.

Activities

Present activities include: holding regular Council meetings; organizing and running annual meetings; publishing *Atlantic Geology*, the only regional geoscience journal in Canada; producing four issues of the AGS Newsletter annually; accepting nominations for the Gesner Medal and the Distinguished Service Award, which are awarded at the annual meetings of the Society; regular meetings of the Education Committee, both the Nova Scotia and New Brunswick branches (teachers are represented on this committee); regular meetings of the Nova Scotia EdGEO Committee (includes several teachers); regular meetings of the AGS Video Committee; hosting annual Nova Scotia EdGEO Workshops, each year in a different location; maintaining the database EarthNet.

Programs

Programs include: the annual meeting and accompanying workshop and/or field trip; the EdGEO Workshops; *Atlantic Geology*; EarthNet.

Who Benefits?

The geological community: including geologists in government, academia, and industry; consultants, prospectors, and amateurs; university students; elementary and high school teachers; elementary and high school students; and the general public.

Geographical Area

New Brunswick, Nova Scotia, Prince Edward Island, and to a lesser extent, Newfoundland & Labrador.

Accomplishments

- 1973. The Society became the first and the only affiliated society of the Geological Association of Canada.
- 1974. The first AGS Colloquium, "The geological evolution of the Atlantic Seaboard of Canada", Fredericton, 19th-20th January.
- 1976. The first meeting with the theme, "Current Research in the Maritime Provinces", Mount Allison University, 11th December.
- 1977. AGS hosted a meeting of the Canadian Geoscience Council, 13th October.
- 1977. The Society became an affiliated society of the Canadian Society of Petroleum Geologists.
- 1980. Published the "Geological Highway Map of Nova Scotia". AGS Special Publication no.1
- 1980. Organized and ran the Annual Meeting of the Geological and Mineralogical Associations of Canada.
- 1981. AGS Council agreed that the Society should be associated with Maritime Sediments and Atlantic Geology in an informal way.
- 1985. AGS formally adopted Maritime Sediments and Atlantic Geology as the official journal of the Society.
- 1985. Published the "Geological Highway Map of New Brunswick and Prince Edward Island". AGS Special Publication no.2
- 1985. Published "Carte Routière Géologique du Nouveau-Brunswick et d'Isle du Prince Edouard". AGS Special Publication no.3.
- 1985. Published "Occupational Safety in the Geosciences" (Program with papers, from seminar, 25th September 1985). AGS Special Publication no.3
- 1985. Published through CSPG, "Lexicon of Canadian Stratigraphy, Volume VI, Atlantic Region".
- 1986. Commenced responsibility for publication of Atlantic Geology, which consists of three issues per volume/year.
- 1986. Organized and ran the Symposium, "Basins of Eastern Canada and Worldwide Analogs".
- 1986. Published "Field Trip of Carboniferous-Jurassic Sedimentation and Tectonics: Minas, Cumberland, and Moncton Basins, Nova Scotia and New Brunswick". AGS Special Publication no.4
- 1987. Released the educational video "Mineral Wealth of Atlantic Canada", 26 minutes. AGS Special Publication no.7
- 1987. "Sedimentary Basins and Basin-Forming Mechanisms". Editors, C. Beaumont and A. Tankard, 527p. AGS Special Publication no.5.
- 1988. Released the educational video, "The Appalachian Story", 50 minutes. AGS Special Publication no.8.
- 1989. Published the second edition of "Geological Highway Map of Nova Scotia". AGS Special Publication no.1.
- 1990. Released the educational video, "The Recent Ice Age". AGS Special Publication no.9.
- 1991. "A Guide to the Geology, Landscapes and Mineral Resources of Nova Scotia". AGS Special Publication no.6.
- 1992. Organized and ran the Annual Meeting of the Geological and Mineralogical Associations of Canada
- 1992. Released the educational video, "Offshore Oil and Natural Gas". AGS Special Publication no.10
- 1992. Published "The Appalachian Story Video Guide". AGS Special Publication no.11.
- 1993. Published "Offshore Oil and Natural Gas Video Guide". AGS Special Publication no.12.
- 1994. Ran First Nova Scotia EdGEO Workshop, Halifax-Dartmouth, 22-23 August.
- 1994. Started development of the web site EarthNet.
- 1995. Ran Second Nova Scotia EdGEO Workshop, Sydney, 21-22 August
- 1996. Published, "The Recent Ice Age Video Guide". AGS Special Publication no. 13.
- 1996. Ran Third Nova Scotia EdGEO Workshop, Wolfville, 19-20 August.
- 1997. Ran Fourth Nova Scotia EdGEO Workshop, Bridgewater, 18-19 August.
- 1998. Published "Discovering Rocks, Minerals and Fossils in Atlantic Canada". AGS Special Publication no.14.
- 1998. Ran Fifth Nova Scotia EdGEO Workshop, Truro, 17-18 August.
- 1999. Ran Sixth Nova Scotia EdGEO Workshop, Parrsboro, 23-24 August.
- 2000. Ran Seventh Nova Scotia EdGEO Workshop, Antigonish, 21-22 August.
- 2001. Published "The Last Billion Years: a Geological History of the Maritime Provinces of Canada". AGS Special Publication no. 15. First printing July 2001, second printing November 2001, third printing February 2002.
- 2001. Ran Eighth Nova Scotia EdGEO Workshop, Parrsboro, 20-21 August.
- 2002. Ran Ninth Nova Scotia EdGEO Workshop, Digby, 19-20 August.
- 2003. Published the poster, "The Evolving Maritimes" on 15th March.
- 2003. Ran the Tenth Nova Scotia EdGEO Workshop, Parrsboro, 25-26 March.
- 2004. Published the brochure, "Nova Scotia Rocks", 18th June 2004, AGS Special Publication no.21.
- 2004. Ran the Eleventh Nova Scotia EdGEO Workshop, BIO, Dartmouth, 23rd-25th August.
- 2005. Organized and ran the 2005 Joint Meeting of the Geological Association of Canada, the Mineralogical Association of Canada, and the Canadian Society of Petroleum Geologists, Halifax, 16th-18th May.
- 2005. Published the "Geological Highway Map of Nova Scotia", third edition.
- 2005. Ran the Twelfth Nova Scotia EdGEO Workshop, Halifax, 14th May.
- 2005. Ran the Thirteenth Nova Scotia EdGEO Workshop, Parrsboro, 15th-17th August.
- 2006. Released the education video, "Halifax Harbour: A Geological Journey".
- 2006. Ran the Fourteenth Nova Scotia EdGEO Workshop, Dartmouth, 16th-17th August.
- 2007. Ran the Fifteenth Nova Scotia EdGEO Workshop, Wolfville, 21st-22nd August.

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National, Provincial and Local Affiliations

National:

- Affiliated Society of the Canadian Society of Petroleum Geologists
- Affiliated Society of the Geological Association of Canada
- Representation on the Canadian Geoscience Education Network

Rupert MacNeill Award for Best Student Paper

- 1984 Allan A. Huard, St. Francis Xavier University, for the paper, (with H.C. Teng) "A study of the Fisset Brook Formation at Lake Ainslie, western Cape Breton Island"
- 1985 David Carter, University of New Brunswick, for the paper "Lithostratigraphy of the Late Devonian-Early Carboniferous Horton Group of the Moncton Subbasin".
- 1986 D. Beattie, Dalhousie University, for the paper, "Gravity modeling of a mafic, ultramafic association, Darvel Bay, East Sabah, N. Borneo".
- 1987 Alison Steele, Acadia University. "Petrography and geochemistry of the gabbro-norite 1 subzone, Stillwater Intrusion: a lunar analog study".
- 1988 Wayne McNeil, Acadia University, for the paper (with N. Van Wagoner), "Stratigraphy and physical volcanology of the eastern portion of the Devonian volcanic belt of Passamaquoddy Bay, southwestern New Brunswick".
- 1989 Catherine Farrow, Acadia University, for the paper, "Magmatic epidote and high-aluminum hornblende-bearing diorites and tonalites of the southeastern Cape Breton Highlands, Nova Scotia".
- 1990 Robert MacNaughton, University of New Brunswick, for the paper, "Ichnology of the Triassic Lepreau Formation, southern New Brunswick".
- 1991 C. Beaumont-Smith, University of New Brunswick, for the paper (with Paul Williams), "Textural development in experimental shear zones using analogue materials".
- 1992 David Keighley, University of New Brunswick, for the paper (with R.K. Pickerill), "Strangely preserved flutes and grooves from the fluvial Port Hood Formation, (Carboniferous) of western Cape Breton Island, Nova Scotia".
- 1993 Marcus Tate, Dalhousie University, for the paper (with Barrie Clarke), "Weekend dykes, a suite of Late Devonian spessartite lamprophyres in the Meguma Zone of Nova Scotia".
- 1994 Jodie E. Smith, McMaster University, for the paper (with M.J. Risk, A. Ruffman and P. Mudie), "A new archive: Late Quaternary climatic reconstruction using the deepwater coral *Desmophyllum cristagalli*".
- 1995 Ellen Tobey, Dalhousie University, for the paper (with Megan McConnell, Paul E. Schenk and Peter H. Von Bitter), "Carbonate microbial mounds, mineralized vents, periplatformal oozes and slump domes in Macumber equivalents, eastern Cape Breton".
- 1995 Tammy Allen, Dalhousie University, for her paper, "A study of carbonate rocks from the Late Visean to Namurian Mabou Group, Cape Breton Island, Nova Scotia".
- 1995 Marcus Tate, Dalhousie University, for the paper (with D.B. Clarke and M.A. MacDonald), "Late Devonian mafic-felsic magmatism in the Meguma zone".
- 1996 Vanessa Gale, Dalhousie University, for the paper, "Paleotectonic setting and petrogenesis of the Takla Group volcano-sedimentary assemblage, north-central British Columbia".
- 1997 Jennifer van der Gaag, for the paper, "Characterization of outburst channel sandstones in the Phalen Colliery, Cape Breton, Nova Scotia"
- 1998 Mark Deptuck, Saint Mary's University, for the paper, "Characterization and interpretation of Late Cretaceous to Eocene erosional features and associated submarine fan deposits in the Jeanne d'Arc Basin, offshore Newfoundland".

- 1999 Krista Page, Dalhousie University, for the paper (with Anne Marie O'Beirne-Ryan), "Uranium, radium, and radon in streams and domestic well waters: a GIS analysis of geological, geochemical, and geophysical relationships"
- 2000 Michael Young, Dalhousie University, for the paper, "Minor folds and their relationship to regional fold evolution, central Meguma Terrane, Nova Scotia".
- 2001 Michelle DeWolfe, Saint Mary's University, for the paper, "Petrological evidence for extensive liquid immiscibility in the Jurassic North Mountain Basalt, Nova Scotia".
- 2002 David Risk, Saint Francis Xavier University, for the paper (co-authored with Lisa Kellman and Hugo Beltrami), "Physical processes controlling soil respiration: results from four sites in eastern Nova Scotia".
- 2003 No award, because of joint meeting with GSA, north eastern section.
- 2004 Chris Hamilton, Dalhousie University, for the paper, "Ice-contact volcanism in southwest Iceland: analysis of hyaloclastic flow deposits using remote sensing, stratigraphy, and geochemistry".
- 2005 Nigel Selig, Dendrochronology Lab, Department of Geography, Mount Allison University, for the paper (co-authored by A. Robichaud and C.P. Laroque), "A history mystery: dendroarchaeological investigations at the Campbell Carriage Factory".
- 2006 Adam Layman, Dalhousie University, for the paper (with Alan Anderson), "Preliminary investigations of Nb in melt-fluid systems using *in situ* X-ray spectroscopy".
- 2007 Marc Laflamme, Queen's University, for the paper (with Guy Narbonne), "Tiering in Ediacaran fronds from Mistaken Point, Newfoundland".

Graham Williams Award for Best Student Poster

- 1997 Sandra Marshall, Acadia University, for the poster (with Ian S. Spooner), "An investigation of drumlins in southwestern Nova Scotia: distribution, orientation and mode of formation".
- 1998 Nicole A. Quickert, Dalhousie University, for the poster (with Dorothy I. Godfrey-Smith, Joanna L. Casey, and Alicia Hawkins), "Optically and thermally stimulated luminescence dating of Birimi, a multi-component archaeological site in Ghana, Africa".
- 1999 Loretta Ransom, St. Francis Xavier University, for the poster (with B. Murphy and D.J. Kontak), "Occurrence of microgarnets coring plagioclase crystals in granodiorite of the South Mountain Batholith, Nova Scotia".
- 2000 Christie Dyble, Acadia University, for the poster, "A high resolution stratigraphic and petrological investigation of the Braeburn Member, Charlie Lake Formation, Peace River Arch, northwestern Alberta: reservoir implications".
- 2001 Martin Ethier, Acadia University, for the poster, "Reinterpretation of the geology of the Cape Breton Highlands using remote sensing and geological databases".
- 2002 David Moynihan, Dalhousie University, for the poster (with Chris White and Rebecca Jamieson), "Metamorphism and structure of the White Rock Formation in the Yarmouth area, Nova Scotia".
- 2003 No award because of joint meeting with GSA, northeastern section.
- 2004 Shawna Weir Murphy, Saint Mary's University, for the poster, "Cretaceous rocks of Orpheus Graben, offshore Nova Scotia".
- 2005 Tansy O'Connor-Parsons, Acadia University for the poster (with C.R. Stanley), "Downhole trace and major chronostratigraphic patterns relating to igneous fractionation processes in the Golden Mile Dolerite, Western Australia".
- 2006 Brent Lennox, Acadia University for the poster (with Ian Spooner), "Post-glacial climate change and its effect on the thermal structure and habitat in a shallow dimictic lake, Nova Scotia, Canada".
- 2007 Helen Neilson, Dalhousie University for the poster (with John Gosse), "Landform evolution in the south central Andes: determining the major mechanisms of formation of the great escarpment between 32 and 38 degrees south, Argentina".

Noranda Award for Best Student Paper in Economic Geology

- 1997 Kelly Janssens, University of New Brunswick, for the paper (with Tom A. Al), "Geochemical changes in the soil profile due to deforestation".
- 1998 Lorne C. Jennex, St. Francis Xavier University, for the paper (with J.B. Murphy and A.J. Anderson), "Geological and geophysical investigation of the western St. Mary's Basin, central Mainland Nova Scotia: implications for paleoplacer potential".
- 1999 Geoff Allaby, University of New Brunswick, for the paper (with B.E. Broster and A.G. Pronk), "Late Wisconsinan glacial movement in the Petitcodiac map area, southeastern New Brunswick".
- 2000 Ian DeWolfe, Acadia University, for the poster, "Structural and geometrical analysis of saddle reef folds at the mesothermal gold deposit, Port Dufferin, Halifax County, Nova Scotia: implications for future exploration and resource assessment".
- 2001 Lawrence Mireku, Acadia University, for the paper, "Geology, geochemistry and hydrothermal alteration of the Lower AB Zone, Halfmile Lake North volcanic hosted massive sulphide deposit, Bathurst, New Brunswick".
- 2002 Noranda decided to terminate award because of reduced activity in the Maritimes.

Gesner Medal

1993	Les Fyffe, New Brunswick Department of Natural Resources and Energy
1994	Art Ruitenberg, New Brunswick Department of Natural Resources and Energy
1995	Sandra Barr, Acadia University
1996	Ron Pickerill, University of New Brunswick
1997	John Malpas, Memorial University
1998	Paul Schenk, Dalhousie University
1999	No award
2000	David Piper, Geological Survey of Canada (Atlantic)
2001	Brendan Murphy, St. Francis Xavier University
2002	Martin Gibling, Dalhousie University
2003	Georgia Pe-Piper, Saint Mary's University
2004	Al Grant, Geological Survey of Canada (Atlantic)
2005	John Calder, Nova Scotia Department of Natural Resources
2006	Barrie Clarke, Dalhousie University
2007	Jarda Dostal, St. Mary's University

AGS Distinguished Service Award

1989	Laing Ferguson, Mount Allison University, termed the Special Service Award at the meeting
1990	Howard Donohoe, Nova Scotia Department of Natural Resources
1991	Aubrey Fricker, Atlantic Geoscience Centre
1992	No award
1993	Graham Williams, Atlantic Geoscience Centre
1994	Ken Howells, Nova Scotia Research Foundation
1995	Brendan Murphy, St. Francis Xavier University
1996	No award
1997	Norman Lyttle, Nova Scotia Department of Natural Resources
1998	No award
1999	No award
2000	Peter Wallace, Dalhousie University
2001	Michael Parkhill, New Brunswick Department of Natural Resources, Bathurst.
2002	Rob Fensome and Graham Williams, Geological Survey of Canada (Atlantic)
2003	Bob Grantham, Johnson GEO CENTRE
2004	Jennifer Bates, Geological Survey of Canada (Atlantic)
2005	Ron Pickerill, University of New Brunswick
2006	Sandra Barr, Acadia University
2007	Sue Johnson, New Brunswick Department of Natural Resources and Energy, Sussex

AGS-Photographic Guild of Nova Scotia Geology and Photographic Competition

2003	Wayne Garland, North Mountain Basalt and Blomidon Formation, Five Islands Provincial Park
2004	Philip Giles, Stromatolites in Shark Bay, Western Australia
2005	Philip Giles, Lowell Glacier
2006	Keith Vaughan, Hickman Arch
2007	Elio Dolente, Noel Shore

The Last Billion Years Award, Photographic

2004	John William Webb, Walton Cliffs
2005	Wayne Garland, Economy Cliffs I
2006	Wayne Garland, Economy Cliffs II
2007	Elio Dolente, Noel Shore

Life Time Membership

1989	Laing Ferguson, Mount Allison University.
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Field Trips

?	The Cobequids, Georgia Pe-Piper and David Piper.
?	Saint John, Sandra Barr.
1990	South Mountain Batholith, leaders: Michael MacDonald, ?
1990	Cobequid Highlands, leaders Howard Donohoe and Gary Yeo.
1992	Grand Manan Island, Richard Grant.
1994	Tancook Island, John Waldron.

- 1996 In conjunction with Colloquium, tour of Brunswick No. 12 Mine and Mill, leaders Bill Luff and Dave Lentz.
- 1997 In conjunction with Colloquium, Potash Corporation of Saskatchewan's Mine, Sussex, NB, Brian Roulston.
- 1997 Yarmouth and Shelburne Counties, Rob Raeside and Ralph Stea.
- 1998 Visit to Nova Scotia College of Geographic Sciences, Lawrencetown, Tim Webster
- 1998 Joggins/Parrsboro, John Calder
- 2004 In conjunction with Colloquium: Potash Corporation of Saskatchewan's Mine, Sussex, NB, Brian Roulston.
- 2004 Volcanology of Northern New Brunswick - Silurian- and Devonian-Aged Chaleurs and Dalhousie Groups, 1-3 October, Reg Wilson
- 2006 In conjunction with Colloquium: Visit to Nova Scotia College of Geographic Sciences, Lawrencetown, Tim Webster.

Workshops

- 1987 John Spray, Metamorphism in basic-ultrabasic complexes.
- 1987 APICS Workshop, organized by Graham Williams, Maturation studies and petroleum geology
- 1988 Computer Applications in Geology.
- 1989 Alan Dickin, Sm-Nd isotopic techniques.
- 1990 Martin Gibling and David Piper, Recent developments in facies models.
- 1991 Edward Sampson and Howard Donohoe, APICS Workshop on Communications.
- 1993 Louis Cabri, Mineralogy and extractive metallurgy of precious-metal mineralization.
- 1994 No Record
- 1995 Michael Parkhill and Graham Williams, The teaching of geoscience in the schools.
- 1996 Mel Best, Pierre Keating, and Mike Thomas, Exploration Geophysics Workshop I and II.
 - I. Gravity and magnetic prospecting for massive sulphide deposits.
 - II. Electromagnetic prospecting for massive sulphide deposits.
- 1997 David Lentz and Scott Swinden, An introduction to practical lithogeochemistry.
- 1998 Peter Reynolds, Dorothy Godfrey-Smith, and Keith Taylor, Quaternary geochronology: a workshop on the theory and application of luminescence, fission track and argon dating methods 1999 Howard Donohoe, Geoscience Software for the Professional Teacher and Student.
- 2000 Tom Al, Low Temperature Aqueous Geochemical Modelling with Applications primarily from Environmental Geosciences.
- 2004 Alan Anderson, Instrumental Development and Application of the Ion Microprobe
- 2005 Jennifer Bates and Randy Miller, Geo-communication: getting your message across to peers and public.
- 2006 Michael Robertson (Acadia Physics Dept.), Dan MacDonald (ACMA) and Peir Pufahl (Acadia Geology Dept.), Cathodoluminescence techniques at the Acadia Centre for Microstructural Analysis.
- 2007 Ryan Toole and David Lentz, A review of physical Volcanology: a metallogenic perspective (UNB SEG_CIM Student Chapter Workshop).
- 2007 Terry A. Goodwin, Rita Mroz and Toon Pronk, North American Soil Geochemical Landscape Project - Maritimes soils project workshop.

Banquet Speakers

- 1974 John Smith, Nova Scotia Department of Mines.
- 1976 Charlie Smith, Energy, Mines and Resources, Canada.
- 1978 Roger Macqueen, Geological Survey of Canada.
- 1979 No Record
- 1980 No Banquet
- 1981 Nean Allman, "The Role of Women in the Mining Industry throughout History".
- 1982 Ray Price, Director, Geological Survey of Canada.
- 1983 Hugh Morris, "Federalism, Provincialism and Separatism".
- 1984 Chris Barnes, Memorial University, "Greater Cooperation and Better Communications between Industry and Academia".
- 1985 John Maher, Canadian Society of Petroleum Geologists, "Geo-economics and Politics from an Oil Finder's Point of View".
- 1986 Alan Coope, "Geological Free Trade".
- 1987 Bill May, Canadian Society of Petroleum Geologists, "Employment Prospects for Geologists in the Current Economic Climate".
- 1988 -
- 1989 Graham Williams, "The AGS - Past and Present".
- 1990 Dirk Templeman-Kluit, Geological Survey of Canada, "Geologists and the Environment".
- 1991 Jim Franklin, Geological Survey of Canada, "Seafloor Hydrothermal Systems and Massive Sulphide Deposits".
- 1992 -
- 1993 Jack Garnett, Consultant, "Turning 21".
- 1994 Frank Blackwood, Newfoundland Department of Mines and Energy.

- 1995 Alan Ruffman, Geomarine Associates, "Earthquakes and Tsunamis of Eastern Canada: cause for concern?"
- 1996 Emlyn Koster, Ontario Science Centre, "Prospectives on the Why? How? And When? In the Public Awareness of Science".
- 1997 Graham Williams, Geological Survey of Canada (Atlantic), "A Serious History of the AGS".
- 1998 Godfrey Nowlan, Geological Survey of Canada (Calgary), "Public Perception of Science".
- 1999 Mike MacDonald, Nova Scotia Department of Natural Resources, "Adventures in Mongolia".
- 2000 Ian Hutcheon, President of the Canadian Society of Petroleum Geologists, "CO₂ emissions and hydrocarbons: a geochemist's perspective".
- 2001 Scott Swinden, Nova Scotia Department of Natural Resources, "Geoscience in a dot.com world - living in a time of change".
- 2002 Gordon Fader, Geological Survey of Canada (Atlantic), "Multibeam bathymetry: a revolution in marine geology".
- 2003 Steve Blasco, Geological Survey of Canada (Atlantic), "Diving to the Titanic".
- 2004 Djordje Grujic, Dalhousie University, "Journeys in the Kingdom of the Flying Dragon: Mountains, people and geology of the Bhutan Himalaya".
- 2005 Joe Kelly, "Landslides and eroding glacial bluffs: a problem common to New England and the Maritime Provinces".
- 2006 David Mosher, GSC (Atlantic), "To the Heart of the Tsunami: the Sumatra Earthquake and Tsunami Offshore Survey (SEATOS)".
- 2007 David Piper, GSC (Atlantic), "Apprenticeship in Geology: A Second Look".
- 2008 Godfrey Nowlan, GSC (Calgary), "Earth to Canadians: Communicating Earth Science in the Year of Planet Earth"

AGS Presidents 1972-2007

1972-1973	Rupert MacNeill	Acadia University
1973-1974	Michael Keen	Dalhousie University
1974-1975	Nick Rast	University of New Brunswick
1975-1976	John Smith	Nova Scotia Department of Mines and Energy
1976-1977	David Piper	Dalhousie University
1977-1978	Graham Williams	Atlantic Geoscience Centre, Bedford Institute
1978-1979	Sandra Barr	Acadia University
1979-1980	Howard Donohoe	Nova Scotia Department of Mines and Energy
1980-1982	Alisdair MacKay	Nova Scotia Research Foundation
1982-1983	Laing Ferguson	Mount Allison University
1983-1984	Ken Howells	Nova Scotia Research Foundation
1984-1985	Chris Beaumont	Dalhousie University
1985-1986	Norman Lyttle	Nova Scotia Department of Mines and Energy
1986-1987	Aubrey Fricker	Atlantic Geoscience Centre, Bedford Institute
1987-1988	Nancy Van Wagoner	Acadia University
1988-1989	Pat Ryall	Dalhousie University
1989-1990	Brendan Murphy	Saint Francis Xavier University
1990-1991	John Waldron	Saint Mary's University
1991-1992	David Mossman	Mount Allison University
1992-1993	Dan Kontak	Nova Scotia Department of Natural Resources
1993-1994	Les Fyffe	New Brunswick Department of Natural Resources and Energy
1994-1995	Brian Roulston	Potash Corporation of Saskatchewan
1995-1996	Susan Johnson	New Brunswick Department of Natural Resources
1996-1997	Michael Parkhill	New Brunswick Department of Natural Resources
1997-1998	Peter Wallace	Dalhousie University
1998-1999	Rob Raeside	Acadia University
1999-2000	Chris White	Nova Scotia Department of Natural Resources
2000-2001	Mike MacDonald	Nova Scotia Department of Natural Resources
2001-2002	Tom Martel	Corridor Resources Inc.
2002-2003	Jennifer Bates	Geological Survey of Canada (Atlantic)
2003-2004	Reg Wilson	New Brunswick Department of Natural Resources
2004-2005	Joe White	University of New Brunswick
2005-2006	Dave Keighley	University of New Brunswick
2006-2007	Ian Spooner	Acadia University
2007-2008	Michael Parsons	Geological Survey of Canada (Atlantic)

AGS Annual Meetings, variously called Colloquia and Symposia

- 1974** Symposium, Natural Resources of the Maritimes, Wandlyn Inn, Fredericton, New Brunswick, 19-20 January.
- 1975** Colloquium, Natural Resources of Atlantic Canada, Wolfville, Acadia University, Wolfville, Nova Scotia, 23-24 January.

- 1976** One Day Colloquium, Current Research in the Maritimes, Mount Allison University, Sackville, New Brunswick, 11 Dec. *Geolog*, v.6, pt.1.
- 1978** Third Biennial Symposium, Keddy's Motor Inn, Fredericton, New Brunswick, 20-21 Jan. *Geolog*, v.7, pt.2.
- 1979** Second Biennial Colloquium, Current Research in the Maritimes, Wandlyn Inn, Amherst, Nova Scotia, 19-20 Jan. *Geolog*, v.8, pt.1.
- 1980** First Special Symposium, Lower Paleozoic Rocks of the Atlantic Region, Wandlyn Inn, Amherst, Nova Scotia, 19 Jan. *Geolog*, v.9, pt.2.
- 1981** Symposium, Mineral and Energy Resources of Atlantic Canada, Keddy's Motor Inn, Fredericton, New Brunswick, 23-24 Jan. *Geolog*, v.10, pt.2.
- 1982** Colloquium, Current Research in the Maritimes, Wandlyn Inn, Amherst, Nova Scotia, *Geolog*, v.11, pt.2.
- 1983** Symposium, The History, Development and Economic Potential of Sedimentary Basins in Eastern and Offshore Canada, Keddy's Motor Inn, Fredericton, New Brunswick, 28-29 Jan. *Geolog*, v.12, pt.2.
- 1984** Colloquium, Current Research in the Atlantic Provinces, Wandlyn Inn, Amherst, Nova Scotia, 21-22 Jan. *Geolog*, v.13, pt.2.
- 1985** Biennial Symposium, Tectonic Models for the Evolution of the Appalachian Region, Old Orchard Inn, Wolfville, Nova Scotia, 18-19 Jan. *Geolog*, v.14, pt.2.
- 1986** Biennial Colloquium, Current Research in the Atlantic Provinces, Wandlyn Inn, Amherst, Nova Scotia. 17-18 Jan. *Geolog*, v.15, pt.3.
- 1987** Symposium and Workshops, Howard Johnson Motor Lodge, Fredericton, New Brunswick, 6-7 Feb. *Geolog*, v.16, pt.2.
- 1988** Biennial Colloquium, Best Western Claymore Inn, Antigonish, Nova Scotia. 5-6 Feb. *Maritime Sediments and Atlantic Geology*, v.24, no.2.
- 1989** Colloquium, Wandlyn Inn, Amherst, Nova Scotia, 3-4 February, *Atlantic Geology*, vol.25, no.2. *Geolog*, v.18, pt.2.
- 1990** Symposium, New Age Determinations in the Atlantic Provinces; Colloquium, Current Research in the Atlantic Provinces, Old Orchard Inn, Wolfville, Nova Scotia. 8-9 Feb. *Geolog*, v.19, pt.2.
- 1991** Colloquium, Current Research in the Atlantic Provinces, Wandlyn Inn, Amherst, Nova Scotia, 8-9 Feb. *Geolog*, v.20, pt.2.
- 1992** Symposium, Devonian-Carboniferous Magmatism, Deformation, Metamorphism, and Related Mineralization in the Atlantic Provinces: Colloquium, Current Research in the Atlantic Provinces, Fredericton Motor Inn, Fredericton, New Brunswick, 31 Jan-1 Feb. *Atlantic Geology*, v.28, no.2.
- 1993** Annual Colloquium and Symposia, Citadel Inn, Halifax, Nova Scotia, 12-13 Feb. *Geolog*, v.22, pt.3.
- 1994** Colloquium, Current Research in the Atlantic Provinces, Wandlyn Inn, Amherst, Nova Scotia, 4-5 Feb.
- 1995** Colloquium and Annual General Meeting, Best Western Claymore Inn, Antigonish, Nova Scotia, 3-4 Feb. *Geolog*, v.24, pt.1
- 1996** Colloquium and Annual General Meeting, Keddy's Le Chateau Bathurst, Bathurst, New Brunswick, 2-3 Feb. *Geolog*, v.25, pt.2.
- 1997** 25th Anniversary Colloquium and Annual General Meeting, Current Research in the Atlantic Provinces, Wandlyn Inn, Amherst, Nova Scotia, 7-8 Feb.
- 1998** Colloquium and Annual General Meeting, Current Research in the Atlantic Provinces, Old Orchard Inn, Wolfville, Nova Scotia, 6-7 Feb.
- 1999** Annual General Meeting and Colloquium, Wandlyn Inn, Amherst, Nova Scotia, 5-6 Feb.
- 2000** Annual General Meeting and Colloquium, Fredericton Inn, Fredericton, New Brunswick, 10-12th February, 2000; joint meeting with The Environmental Earth Sciences Division (EESD) of the Geological Association of Canada, Current Environmental Research and Foci for the Next Century
- 2001** Twenty-ninth Annual Colloquium and Annual General Meeting, Delta Beausejour Hotel, Moncton, New Brunswick, 9-10th February. *AGS Newsletter*, v.30, no.2.
- 2002** Colloquium and Annual General Meeting, Greenway Claymore Inn, Antigonish, Nova Scotia, 8-9th February.
- 2003** AGS/Northeastern Section Geological Society of America, Joint Meeting, Westin Hotel, Halifax, Nova Scotia, 27-29th March.
- 2004** AGS Colloquium and Annual General Meeting, Hotel Beausejour, Moncton, New Brunswick, 30th -31st January, *AGS Newsletter*, v. 33, no. 2
- 2005** AGS Colloquium and Annual General Meeting, Saint John Trade and Convention Centre and Hilton Hotel, Saint John, New Brunswick, 4th -5th February. *AGS Newsletter*, v.34, no.2
- 2006** AGS Colloquium and Annual General Meeting, Old Orchard Inn, Wolfville, Nova Scotia, 3rd-4th February.
- 2007** AGS Colloquium and Annual General Meeting, Hotel Beausejour, Moncton, New Brunswick, 2nd-3rd February.
- 2008** AGS Colloquium and Annual General Meeting, Holiday Inn Harbourview, Dartmouth, Nova Scotia, 1st-2nd February.

ATLANTIC GEOSCIENCE SOCIETY
LA SOCIÉTÉ GÉOSCIENTIFIQUE DE L'ATLANTIQUE
2008 LUNCHEON and ANNUAL GENERAL MEETING
Saturday, 2 February, 2008, 12 noon to 2.00 pm
Alderney Room, Holiday Inn Harbourview, Dartmouth, Nova Scotia

AGENDA

- 1) Approval of Agenda
- 2) Approval of minutes of 3 February, 2007, Annual General Meeting, Moncton, NB
- 3) Matters Arising from the Minutes
 - a) AGS History
- 4) Annual Reports of the 2007-08 Executive and Committees
 - Report from the President (Parsons)
 - Report from the Education Committee (Bates)
 - Report from the EdGeo Workshop Committee (Bates)
 - Report from the Video Committee (Williams)
 - Report from the Products Committee (Raeside)
 - Report from Atlantic Geology editors (Barr)
 - Report from the APICS Committee (Murphy)
 - Report from Publicity Coordinator (Kosters)
 - Report from Publications Committee
 - Report from Webmaster (Joe MacIntosh)
- 5) Presentation of the Financial Report (Howells)
- 6) Appointment of Financial Reviewers for 2009
 - 7) Changes to By-Laws

Be It Resolved That the 2007 AGS by-laws be amended as follows

43. "These awards are the Distinguished Scientist Award (Gesner Medal) and the Distinguished Service Award" will be amended to state "These awards are the Distinguished Scientist Award (Gesner Medal) and the Distinguished Service Award (Laing Ferguson Award)."

insert:

ATLANTIC GEOLOGY

45. Atlantic Geology is the official journal of the Atlantic Geoscience Society. The editors of Atlantic Geology are appointed by AGS Council. The number of editors and their terms of office are not fixed. The editors are volunteers, and are responsible for all aspects of managing and producing the journal. At their discretion the editors may appoint a board of associate editors to assist with the reviewing process and to solicit manuscripts in their areas of expertise and/or places of work.

46. The finances of the journal are managed by the editors, who determine subscription rates. The journal has a Production Manager, selected by the editors subject to AGS Council approval. The Production Manager assists the editors with maintaining subscription and financial records, and preparing manuscripts for publication. The Production Manager is paid by the journal at a rate determined from time to time by the editors and AGS council. It is the responsibility of the Production Manager, in consultation with the editors, to produce an annual financial report for the AGS treasurer. The financial records are checked by an individual AGS member not closely connected to the journal and appointed by AGS at its annual business meeting.

47. The editors submit reports on journal status upon request to AGS Council, and also report annually at the AGS business meeting.

Renumber items 45-50 as 48-53.

Be It Resolved That the Duties of Officers and Standing Committees of the AGS be revised as follows:
Insertion of three sections:

Student Liaison Officer

1. Attends, or ensures that another representative from AGS attends the annual AUGC conference for the purpose of awarding AGS certificates and/or prizes that may from time to time be authorized by Council, to student presenters.
2. Circulates promotional materials to Atlantic region earth science departments and/or their student clubs in order to inform students of AGS activities, encourage them to take out AGS memberships and to participate at the annual Colloquium.
3. Solicits input from students and /or student clubs at Atlantic region earth science departments, to determine ways in which AGS can better serve students' needs.
4. Legitimate expenses, supported by receipts, incurred by the SLC on behalf of AGS may be reimbursed by the Treasurer.

Video Committee

1. The Video Committee is a Standing Committee with all the rights and responsibilities afforded to a Standing Committee. (41, 42)

Nova Scotia EdGeo Workshop Committee

1. The Nova Scotia EdGeo Workshop Committee is established as a Standing Committee with all the rights and responsibilities afforded to a Standing Committee. (41, 42)

8) Election of Incoming Executive & Councillors

9) Other Business Arising from Meeting

10) Adjournment

Minutes of the 33rd Annual General Meeting of the Atlantic Geoscience Society

Saturday, 3 February, 2007, 12.20 p.m. to 1.40 pm

Delta Beausejour Hotel, Moncton, New Brunswick

MINUTES OF MEETING

President I. Spooner called the meeting to order at 12.20 p.m., with 68 present.

1) Approval of Agenda

C. Stanley moved, S. McCutcheon seconded, that the agenda be approved as distributed. Carried.

2) Approval of minutes of 4 February, 2006, Annual General Meeting, Wolfville, NS

C. Stanley moved, J. Gosse seconded, that the minutes be accepted. Carried

3) Matters Arising from the Minutes

a) Appendix to By-Laws

President I. Spooner reported that the appendix to the by-laws was revised, approved by Council in May 2006, and is now posted on the website.

4) Annual Reports of the 2006-07 Executive and Committees

Report from the President (Spooner)

Report from the Education Committee (Bates)

Report from the EdGeo Committee (Bates)

Report from the Video Committee (Williams)

Report from the Products Committee (Raeside)

Report from Atlantic Geology editors (Barr)

Report from the APICS Committee (Murphy)

The reports from the president, most committees and AG editors were circulated in advance. J. Bates and G. Williams were not present in person. Further, R. Raeside reported that the Products Committee had recently received its first submission in the past two years, and was ready to take action. S. Barr reported that the Atlantic Geology submission process is now available on-line and she strongly encouraged all members to be the first to submit using this new system.

C. Stanley moved, S. McCutcheon seconded, that the reports be accepted in block. Carried.

J. Calder moved, and it was widely seconded, that the society formally express its thanks to D. McMullin for his fastidious care and excellence in his work for as production and business manager for Atlantic Geology. Carried.

5) Presentation of the Financial Report (Howells)

K. Howells distributed copies of the reviewed annual financial report (2006). C. Stanley moved, E. Kusters seconded, that the report be accepted. A. Ruffman requested royalties accrued from *The Last Billion Years* be made known (matter conveyed as an action item to the Education Committee). P. Ryall recommended that large sums of money retained by committees be invested. The motion was carried.

6) Appointment of Financial Reviewers for 2008

E. Kusters volunteered to act as reviewer for the Atlantic Geology books. A. Miller nominated P. Ryall as reviewer in Halifax. There were no further nominations and E. Kusters and P. Ryall were declared elected.

7) Changes to By-Laws

C. Stanley moved, A. Ruffman seconded that the 2006 AGS by-laws be amended as follows:

41. The Society, in addition to the Nominations Committee ([see by-law 24](#)), shall have standing committees on the following matters:

- *Awards*
- *Education*
- *Products*
- *Publications*
- *Video*
- *Nova Scotia EdGeo*

All standing committees shall consist entirely of members in good standing with the Society. Standing committees shall be able to form ad-hoc sub-committees that report to the standing committee. Sub-committees may contain a minority of persons who are not members of the Society.

Motion carried, 2 nay votes, 3 abstentions.

A. Ruffman moved, D. Piper seconded, that council be requested to provide clarification on the status of the committee of Atlantic Geology editors. Carried.

8) Election of Incoming Executive & Councillors

D. Keighley recorded thanks to councillors McCutcheon, Wallace and Wilson who were stepping down at this annual meeting. D. Keighley moved, A. Ruffman seconded, that the report of nominations be accepted and that the slate of nominees be elected. Carried.

9) Other Business Arising from Meeting

President I. Spooner requested input from membership concerning the feasibility of an earlier start to the annual colloquium, possibly on Friday at 1 p.m., and on the membership's preference to retain 2 simultaneous session rather than 3. He further announced that the next meeting will be held in Halifax, likely on the second weekend in February. M. Parkhill further noted that a significant saving in the cost of the conference could be made by omitting a printed copy of all abstracts. A. Ruffman noted that an outdated version of the history of the Society had been included in the meeting package this year.

J. Calder presented President I. Spooner with a ball-cap to recognize the support of the Society in the efforts to have the Joggins site declared as a World Heritage Site.

10) Adjournment

Meeting adjourned on a motion by C. Stanley, seconded by J. Waldron. Carried.

Report of Nominations

Retiring (retired)

Steve McCutcheon – NB DNR, Bathurst
Peter Wallace – Dalhousie U, Halifax
Reg Wilson – NB DNR, Bathurst

Randy Miller – NB Museum, Saint John
Deborah Skilliter – NS Museum, Halifax
Kathleen Thorne – NB DNR, Fredericton
Grant Wach – Dalhousie U, Halifax
Jim Walker – NB DNR, Bathurst
Chris White – NS DNR, Halifax

Councillors

Karl Butler – UNB, Fredericton
Grant Ferguson - St FX, Antigonish
Fenton Isenor – Cape Breton U, Sydney
Sue Johnson – NB DNR, Sussex
Dave Keighley – UNB, Fredericton
Andy Kerr – NL DNR, St Johns
Andrew McRae – Saint Mary's U, Halifax
Ann Miller – Industry, Halifax

Executive Councillors

President – Mike Parsons, GSC Atlantic, Dartmouth
Past President – Ian Spooner, Acadia U, Wolfville
Secretary – Rob Raeside – Acadia U, Wolfville
Treasurer – Ken Howells – Industry, Halifax
Vice President – vacant

2007-2008 PRESIDENT'S REPORT

For a regional organization, the Atlantic Geoscience Society has a very large footprint. During my term as President over the last year, I have had many opportunities to discuss AGS and its activities with colleagues all across the country, and most are surprised and impressed to learn just how busy the geoscience scene is here in Atlantic Canada. The success of AGS can be attributed to the tireless efforts of volunteers all across the region, the high quality of AGS publications, and the Society's focus on communicating the importance of geoscience to many different audiences. On behalf of the Society, I want to thank all those who have helped AGS to fulfill its mandate during the past year, including members of AGS Council, the dedicated members of various AGS Committees, and the Editorial Team of Atlantic Geology.

This year started out on a high note, with the very successful 33rd AGS Colloquium and Annual General Meeting in Moncton. Thanks to the hard work of the Local Organizing Committee (led by Sue Johnson, Mike Parkhill, and Reg Wilson) and the generous support of sponsors, the Colloquium attracted 165 registrants and generated a surplus of \$2884. The Society's Distinguished Scientist Award (Gesner Medal) was presented to one of the top geologists in our region, Dr. Jarda Dostal of Saint Mary's University, and the Distinguished Service Award went to a very deserving volunteer, Susan Johnson of the New Brunswick Department of Natural Resources. Those of you who attend the AGS Colloquium on a regular basis will have noticed that over the last few years the program has been very full, which has sometimes made it difficult to choose between talks in competing sessions. This year, we're again running three concurrent sessions, and have started the meeting earlier on Friday afternoon to accommodate the demand for talks and to allow more time for networking. While some may view this expanded program as the price of success, for others, it may overlap with class schedules and necessitate an additional overnight stay. Council would like to hear your thoughts and suggestions on the format and scheduling of our annual meeting so that these may be passed along to future organizing committees.

The AGS supported several excellent geoscience events in the past year, including a talk by Dr. Brian Atwater (USGS) on the "Orphan Tsunami of 1700" at Dalhousie in March, the Parrsboro Gem and Mineral Show in August, and the Atlantic Universities Geological Conference (AUGC) at St. Francis Xavier University in October. I attended the Gem and Mineral Show for the first time this year, and was very impressed by the diverse agenda and the enthusiasm of the 2500 or so people who wandered through the Parrsboro arena during the event. This show is an excellent opportunity for AGS to reach out to the public in a room surrounded by rocks and minerals, and to highlight some of our many activities and publications. Members of the AGS Executive also attended an unveiling ceremony for the AGS watercolour paintings (by artist Judy Pennanen) at the Fundy Geological Museum in April, and were on hand for the presentation of two AGS awards at the Photographic Guild of Nova Scotia Annual Award Banquet in May. The AGS Education, EdGeo, and Video committees have also been busy with various events throughout the past year—details are provided in the following reports. Members of AGS are currently active in various projects as part of the International Year of Planet Earth (IYPE); as a result, the geology of the Atlantic Provinces has recently been well represented in national television programs, websites, and a forthcoming book on the geology of Canada.

Throughout 2007, Council dealt with a long list of agenda items over the course of five meetings. One of the most significant accomplishments of the past year was the development of an application form for loans and grants that can be used to request funding for projects that help advance the goals of the Society. The purpose of this form is to clarify what types of projects AGS can and cannot fund, and to ensure that the Products Committee receives all of the information it requires to evaluate applications. The form and AGS funding policy are now available on the AGS website. Council also adopted a new Copyright and Fair Use Policy in April 2007 that will apply to all AGS publications, including videos. Peter Wallace and Rob Fensome helped to develop this policy, which will help to streamline the many requests that AGS receives to use copyrighted materials in its various publications. On a related note, we are very pleased to report that Nelly Koziel of GSC-Atlantic graciously agreed to take over the handling of AGS Publications from Peter Wallace in 2007, and she has been doing an excellent job of cataloguing publications and managing sales on behalf of various events on behalf of AGS. The Society is very grateful to Peter for managing AGS sales over the years, and to Nelly for her willingness to step into this role.

Council is also working on several important initiatives that will continue in 2008-09. We are in the process of establishing closer ties with our affiliated societies, GAC[®] and CSPG, and expect to form an affiliation with AAPG in 2008. An effort is underway to convert selected AGS publications (field trip guides, brochures, etc.) to .pdf format, which will then be distributed through the AGS website. Alternate means of providing support to student organizations are also being considered following a recent invitation from the GAC[®] to make a contribution to their Logan Student Trust Fund.

By all accounts, 2007-08 was a successful year for AGS: membership numbers remain strong (119 regular members and 71 student members), the finances are in excellent shape, and many exciting projects are on the go. Council welcomes (and encourages!) any suggestions or feedback you may have throughout the year, and looks forward to receiving new Proposals for Funding to help advance the geosciences in Atlantic Canada. In closing, I would like to thank everyone for the opportunity to serve as the Society's 35th President, and pass my best wishes along to our incoming President, David Mosher. I am particularly grateful for the support of Past President Ian Spooner, Secretary Rob Raeside, Treasurer Ken Howells, AGS Councillors, Webmaster Joe MacIntosh, Newsletter Editor John Shimeld, and the manager of our e-mail list, Peter Wallace. Finally, I appreciate the hard work and dedication of the Local Organizing Committee of this year's Colloquium, and I thank all of you for joining us here in Dartmouth to celebrate yet another excellent year for the Atlantic Geoscience Society.

ATLANTIC GEOSCIENCE SOCIETY EDUCATION COMMITTEE ANNUAL REPORT FOR 2007

Nova Scotia Branch

You may think that the Nova Scotia Branch of the AGS Education Committee was less active this year. But it is an optical illusion. Or perhaps they have been side-tracked. There are many in the geoscience community contributing in one way or another to the development of the geology of Canada book. The task of producing and publishing "Four Billion Years and Counting: Canada's Geological Heritage" (FBY) is tremendous and overwhelming at times. But it is worthwhile as it will deliver a book that all of us are anxious to see and read. The editorial board includes Aicha Achab, John Clague, David Corrigan, Rob Fensome, Jim Monger, Godfrey Nowlan and Graham Williams. And there are many AGS members who are contributing to this project by providing content (text, graphic images, photographs), co-ordinating various aspects of the development and production, sitting on committees, and reviewing drafts. A flyer outlining the project and the book's content is included in the Colloquium registration package. Additional copies may be obtained at the AGS booth.

The FBY book is a cornerstone of the Canada's efforts to celebrate the International Year of Planet Earth (IYPE). Other planned projects include a competition for high school students, Geo-time Trails, a careers website, fact sheets, and various types of education resources and activities. Please visit the IYPE website <http://www.iypecanada.org/> for updates on the projects and activities happening across Canada throughout 2008-09.

The sixth season of the *Beyond "The Last Billion Years"* public talk series was held at the Bedford Institute of Oceanography (BIO) in Dartmouth. Five talks were held throughout 2006-07 but the new venue did not draw the large crowds as in previous years at the NS Museum of Natural History (NSMNH). The latter has a dedicated audience that seems to regularly attend such events. The sixth talk on Canada's geological role in Law of the Sea could not be scheduled but is expected to be part of the 2008-09 line-up. The Open House held at BIO absorbed much of the Committee's time in the fall of 2007. Three talks are planned for spring 2008 and they will be at the NSMNH. A promotional flyer listing the speakers and their talk titles is provided in the Colloquium registration package.

AGS is now a member society of the Halifax Young Naturalist Club. The Education Committee has agreed to organize one month's program each year. In 2007, Graham Williams gave a talk on climate warming from a geological perspective at the Nova Scotia Museum on the third Saturday of November. On the following Sunday, he ran a field trip for twenty-two participants to York Redoubt, which was really the field exercise developed by fellow member Patrick Potter. A number of possibilities have been suggested for 2008: Mike Parsons on local environmental geology issues, Andrew MacRae to run a lab at St. Mary's, and an Ice Age trip by an unknown presenter.

The Fundy Basin paintings on display at the Fundy Geological Museum have caught the eye of some people. Museum staff are interested in developing postcards of the paintings. Copyright permission and production costs are as yet undetermined. Developers of the new centre in Tatamagouche where the Brule Fossil Centre will likely relocate are possibly interested in a similar kind of painting. This visual concept that started with Randy Miller at the New Brunswick Museum, will hopefully continue to proliferate. A first draft of the text for a booklet to accompany the Fundy Basin paintings will remain in the review stage until the geology of Canada book is completed.

Collaboration of the AGS with the Photographic Guild of Nova Scotia (PGNS) continues. This year the same person photographer (Rob Fensome can provide his name, if you are interested) won both the *Atlantic Geoscience Society Award* (best geological photograph) and the *"The Last Billion Years" Award* (best Atlantic Canada geological photograph). AGS may use the entered photographs for education purposes. A field trip was not held in 2007 but there is a rumour that the 2008 excursion could be to Kejimikujik's Seaside Adjunct.

With the dwindling number of copies of the 2004 publication *Nova Scotia Rocks* (which remains very popular), the Brochure Committee needs to consider what it needs to do to keep this kind of information available for the public. Andy Henry, chair of the Brochure Committee, recently gathered the members to discuss possibilities. Funding from the original source is not likely but other means of generating a similar product, as hardcopy and/or digital, are being investigated. Andy will have an update at the Education Committee meeting on February 1 as part of the Colloquium. Posting of the pdf version of the pamphlet to the AGS website is not favoured at this time. However, many of the vignettes do reside on the EarthNet education website (URL below).

Interest in *The Last Billion Years* popular geology book remains steady. Purchases are regularly made from Nimbus Publishing and are sold to fill orders or requests for visitors and provide resources for educators. As a reminder, there have been five print runs that correspond to a little more than 8000 copies. Negotiations in 2005 between AGS and Nimbus Publishing led to an agreement whereby the retail price will remain at \$35 and AGS will receive a 5% royalty. This agreement will apply to the next print run. AGS continues to receive a 50% purchase discount regardless of number of copies purchased. Continuing progress of the EarthNet website (www.earthnet-geonet.ca) was slow this year. The Geological Survey of Canada (GSC) does continue to provide a home for the site and we are most grateful for this in kind support. Development continues on a volunteer basis. Ongoing work on contributions from Parks Canada and the University of Ottawa will produce a Virtual Field Trip section that is more representative of the varied geology of Canada. A website developer is ready to create a section on the mastodons of the Maritimes. Funds from the Canadian Geological Foundation will be used to create animation(s?) of geological processes that will enhance several sections of the website. The EarthNet postcard has been given to various education groups and teachers in Canada.

The above-mentioned activities and programs are only made possible by the generous members of the Nova Scotia Branch of the AGS Education Committee: Ken Adams, Dottie Alt, Sandra Barr, Paul Batson, Sally Camus, Carol Corbett, Garth Demont, Howard Donohoe, Warren Ervine, Gordon Fader, Rob Fensome, David Frobel, Martha Grantham, Bob Grantham,

Richard Haworth, Andrew Henry, Fenton Isenor, Chris Jauer, Heather Johnson, George Jordan, Elisabeth Kusters, Andrew MacRae, Henrietta Mann, Chris Mansky, Brian Matthews, Ann Miller, Murray Metherall, Brendan Murphy, Roger Outhouse, Patrick Potter, Pat Ryall, Anne Marie Ryan, John Shimeld, Deborah Skilliter, Brad Tucker, Peter Wallace, Pat Welton, Dustin Whalen, Hans Wielens, Sonya Woods, Graham Williams and Marcos Zentilli.

New Brunswick Branch

A number of the New Brunswick members were active throughout 2007. Toon Pronk continues to make regular school visits, including field trips, to grade 4 classes. He also contributes to a Department of Education effort entitled "Community schools" which tries to incorporate local knowledge and/or business and/or natural features into school life. As a busy outreach person, Toon is also part of the NSERC CRYSTAL Atlantic working group at UNB that is investigating the variables that influence children's interest in science education. With this group, Toon will give three workshops to three different middle school groups in later February. The focus will be Ecoaction Research Zones. These are natural or park areas close to the school that can be a kind of outdoor classroom.

Since the success of the 2005 EdGEO workshop at UNB, there has been talk of a follow-up program. Adrian Park at UNB will discuss the possibility with Science East in Fredericton. It would be wonderful to see another long term presence of EdGEO in the region.

Dave Lentz has stepped down from his position as Chair of NSERC CRYSTAL Atlantic but continues to be active with National Science and Technology Week in the fall at Science East with support from NSERC Atlantic's office. Dave also reports that UNB hopes to have support from their administration to engage a graduate student in visiting schools.

The New Brunswick Branch of the AGS Education Committee includes: Toon Pronk (chair), Dave Lentz, Gwen Martin, Malcolm McLeod, Randy Miller, Mike Parkhill, Jim Walker and Reg Wilson. Welcome to Adrian Park (UNB), a new member who will attend his first meeting of the Committee at the 2008 Colloquium.

Internal and External Collaboration

AGS members are involved in or leading the development of education resources under the auspices of other like-minded groups. Representatives have given reports at meetings: Garth Demont on community interactions; John Calder on designation of Joggins as a World Heritage site; and, Rob Fensome on the Geology of Canada book. Members of the Education Committee also provide feedback on draft versions of resources. Members also provide updates on activities at their respective workplaces particularly museums and centres that offer public education programs such as the Fundy Geological Museum and the Discovery Centre in Halifax. Education activities in Newfoundland and Labrador are organized under the Newfoundland and Labrador section of the Geological Association of Canada. Michelle Miskell is the current chair and has agreed to provide periodic updates on activities on The Rock.

To optimize good internal communications, the Chair of the Education Committee (or designate) is now an ex officio member of AGS Council and reports to Council as requested. Also, the AGS President is an ex officio member of the Committee, receives copies of all meeting minutes and may attend meetings. At present, five members of the Education Committee are members of Council; this also helps to foster communication between the two groups.

The AGS Education Committee is very active and we try to keep AGS members informed of our activities other than through the annual report. Convening an education session at the annual AGS Colloquium is one way. We do attempt to regularly submit articles for the AGS Newsletter. Contributions to GEOLOG, What on Earth, National EdGEO, and science education newsletters are other excellent communication tools. The Education Committee page on the AGS website desperately needs an update. We could do better if we had a volunteer to co-ordinate communications. Meanwhile, please periodically check the AGS newsletter and website for updates and announcements.

Finances

A financial report for 2007 has been prepared by Treasurer Graham Williams. This report will be made available to AGS members at the Annual General Meeting on 2 February 2008. The Committee's account continues to operate "in the black".

Promotion

Promotion is organized by each sub-committee for its event or product. At some AGS events (eg. EdGEO work-shops, public talks, teacher conferences, Parrsboro Rock and Gem Show, AGS booth at annual Colloquium), selected education events/products are promoted and/or available for purchase. A modest amount of sales are made at these public events except at the rock and gem show where sales could be moderately high. Bottom line: We could do better but we need a volunteer to lead this function. We plan to steal away the volunteer who co-ordinates this activity for the AGS Video Committee

I would like to thank Committee members who contributed updates for this report.

Submitted by Jennifer Bates (Chair, AGS Education Committee jbates@nrcan.gc.ca)

ATLANTIC GEOSCIENCE SOCIETY VIDEO COMMITTEE ANNUAL REPORT FOR 2007

The AGS Video Committee continued its momentum in 2007, by conducting an imaginative sales campaign for its latest production, "Halifax Harbour: A Geological Journey". Much of the success was due to the efforts of Nancy Muzzatti, the person responsible for promotions. Nancy has developed contacts throughout the local business community, so that the video can now be found for sale at the Citadel Hill gift shop, the Maritime Museum of the Atlantic, the Nova Scotia Museum of Natural History and local retailers. This has helped sales immeasurably.

One of the major scientific events of 2007 in the Halifax area was the Bedford Institute's Open House. During the two days the Institute was open to the public, the video "Halifax Harbour" was shown continuously on a large-screen television, plus having its own special showing in the Auditorium. Since the video was on sale in the BIO gift shop, business was brisk.

Promotion of the video has also benefited from Gordon Fader's presentations on Halifax Harbour to local groups. At one talk, Gordon managed to sell 15 copies before running out of stock. Such presentations also generate further sales from friends of those attending the talks.

Where does the Committee go from here? One proposal is to produce a video or a series of vignettes about the Bay of Fundy. The hope is that this will be a co-operative effort with the Fundy Geological Museum, the Cape Chignecto Provincial Park and the Joggins Fossil Institute. A committee has been formed, with Ken Adams as chair, to investigate options, to produce a storybook and to come up with possible sources of funding.

A decision was also taken to investigate supporting a video on the Shubenacadie Canal project. After discussions with Bernie Hart and Keith Manchester of the Shubenacadie Canal Commission, it was decided to form a committee to look into the feasibility of this proposal. Bernie Hart, the chair, has already circulated a storybook for modification by the members of the committee. The next concern is to convince the Nova Scotia Department of Education to be responsible for production.

All costs of the AGS Video Committee's projects have been covered by donations, grants and income from videos. This is a considerable achievement for a small, dedicated group. The next major hurdle is to produce the teacher's guide for "Halifax Harbour: A Geological Journey". Even with the promise of a \$3,000.00 grant from the Canadian Geological Foundation, this will not be an easy task. So please tell one of the Committee's members if you know of a good foundation to approach for funding.

The outstanding efforts of the AGS Video Committee over 24 years reflect the qualities of its members. Thank you Jennifer Bates, Gordon Fader, Dave Frobel, David Hopper, Bob Miller, Nancy Muzzatti, Patrick Potter, Peter Underwood and Graham Williams for your continuing commitment and enthusiasm.

REPORT OF THE NOVA SCOTIA EDGEO WORKSHOP COMMITTEE FOR 2007

The Nova Scotia EdGEO Workshop Committee is working to build a new year-round EdGEO program for educators. To start, in 2007, the Nova Scotia committee divided its program between a field-based workshop in August at Acadia University and a presence at the Association of Science Teachers (AST) annual conference in Halifax. The Committee would like to increase the number of activity-based presentations at the AST conference. A yearly contribution to the Social Studies Teachers Association (SSTA) conference program and several thematic mini-workshops throughout the year in schools and to university education students would round out the new program.

The two-day field trip in August was the fifteenth EdGEO workshop co-ordinated by the Nova Scotia Committee since 1994. Sandra Barr and Ian Spooner, in the Department of Earth and Environmental Science at Acadia University, led twenty-two educators through an informative and relevant field trip entitled "Rocks, sand, mud, and scenery: how Earth history controls the human environment in the vicinity of Wolfville, Nova Scotia". Tracy Webb who teaches at the local Horton High summarized the best resources and activities from her many years of leading the Grade 12 geology class; the success of this session told us we will need to always dedicate a part of the workshop program to resources and materials. It also confirmed that including a teacher in the program is important and relevant to K-12 educators. In the evening of the first day, the group gathered in the faculty club for a relaxed dinner and social. Ian gave a presentation on the popular yet complex topic of climate change and it generated plenty of good discussion.

Financial support for the August workshop was generously provided by the National EdGEO Committee. The Geological Survey of Canada (Atlantic), Acadia University, Nova Scotia Department of Natural Resources, Nova Scotia Museum of Natural History, Dalhousie University, Nova Scotia Technical College, various Nova Scotia schools and boards, and Atlantic Science Links Association generously provided in kind support.

At the October AST conference held at Halifax West High School, Sonya Dehler, Rob Fensome and Graham Williams offered a hands-on sessions entitled "Dancing continents, wingless birds and Nova Scotia rocks" for teachers of grades 9-12. Their session description stated "[g]eological time will feature a hands-on events line focussed on Nova Scotia and some of the local highlights, such as Earth's oldest reptiles. The integral role of plate tectonics in the evolution of life and continents will unfold through the eyes of flightless birds, whose distribution today reflects their continental drifting. The concluding session will highlight how the far-flung pieces of Nova Scotia drifted from near the South Pole to their present position." As well, a display table was set up at the AST conference. It was an opportunity to talk to teachers and to tell them about the EdGEO

program and AGS publications and videos. Posters and booklets were very popular. A few AGS products were sold. Several EdGEO alumnae dropped by to talk geology.

The changes to the Nova Scotia EdGEO program provide flexibility for current presenters and growth for new session organizers. Perhaps best of all, teachers now have more professional development opportunities. Plans for the 2008 field trip are underway. Terry Goodwin and Michael Parsons will lead a two-day field trip in the Halifax area on 20-21 August. Participants will learn how geology influences our modern terrestrial and marine environments and discover the intricate connection between human activity and the environment. The Bedford Institute of Oceanography will host the workshop. Registration forms are available from Committee members.

The success of the Nova Scotia EdGEO Workshop Program depends upon the knowledge, experience, enthusiasm and dedication of its Committee. Presenters and Committee members represent both the geoscience and education communities: Dottie Alt (Tatamagouche Elementary School), Paul Batson (Nova Scotia Technical College), Andrew Casey (HRM School Board), Sonya Dehler (GSC Atlantic), Howard Donohoe (NSDNR), Rob Fensome (GSC Atlantic), Terry Goodwin (NSDNR), Iris Hardy (GSC Atlantic), Cindy Hiseler (Annapolis Valley School Board), Heather Johnson (Halifax Independent Elementary School), Nelly Kozziel (GSC Atlantic), Bill MacMillan (GSC Atlantic), Henrietta Mann (Dalhousie University), Murray Metherall (HRM School Board), Nancy Muzzatti (NSMNH), Melanie Oakes (consultant), Michael Parsons (GSC Atlantic and current AGS President), Patrick Potter (GSC Atlantic), Anne Marie Ryan (Dalhousie University), John Shimeld (GSC Atlantic), Kathy Silverstein (HRM School Board), Deborah Skilliter (NSMNH), Wendy Spicer (Annapolis Valley School Board), Hans Wielens (GSC Atlantic), Bev Williams (NS Association of Science Teachers) and Graham Williams (GSC Atlantic).

I encourage you to learn about other AGS education activities by reading the 2008 AGS Education Committee report also in the Colloquium Program. As 2008 is the International Year of Planet Earth (IYPE), I ask you to visit the IYPE website (<http://www.iypecanada.org/>) to learn what is being planned in Canada. We need to generate a greater awareness of society's requirement to better understand the Earth.

Submitted by: Jennifer L. Bates (Chair, Nova Scotia EdGEO Workshop Committee)

APICS EARTH SCIENCE COMMITTEE ANNUAL REPORT FOR 2007

The current APICS Earth Science committee consists of Jarda Dostal (Saint Mary's University), Fenton Isenor (Cape Breton University), Serge Jolicoeur (Université de Moncton), Susan Johnson (New Brunswick Department of Natural Resources), Colin Laroque (Mount Allison University), Ron Pickerill (University of New Brunswick), Peter Wallace (Dalhousie University), Ian Spooner (Acadia University), John Hanchar (Memorial University), Graham Williams (Geological Survey of Canada Atlantic) and Brendan Murphy (chair, St. Francis Xavier University). A member from Nova Scotia Department of Natural Resources will be appointed soon.

An APICS-Earth sciences meeting is scheduled to coincide at the annual Atlantic Geoscience Society Colloquium in Dartmouth, February 1st-3rd 2008. As in past years, the committee cooperates with the Atlantic Geoscience Society to sponsor and organize an APICS-AGS speaker tour, bringing in outstanding scientists to talk about their recent research. At this meeting, we will nominate the APICS-AGS speaker for 2008-2009. The speaker for 2007-2008, is Dr. Mike Parsons, from the Geological Survey of Canada-Atlantic. He specializes in the relationship between ecosystems and human health risks associated with metals in the environment. His research provides a sound scientific basis for developing better environmental quality guidelines and for managing contaminated sites. Dr. Parsons received a B.Sc. in Earth Sciences and Chemistry from Dalhousie University in 1994, and a Ph.D. in Environmental Geochemistry from Stanford University in 2001. He joined GSC-Atlantic in 2001 as a Research Scientist. He is a leader on multidisciplinary projects examining the sources, cycling, and fate of metals and metalloids in both marine and terrestrial environments. His research focus is on environmental impacts of mining and metallurgical operations such as the environmental legacy of historical gold mining (1860s to 1940s) in Nova Scotia, and the effects of the use mercury to extract gold. He also contributes to the study of ocean disposal sites in Atlantic Canada. He is an Adjunct Professors at Dalhousie, Saint Mary's, and Queen's universities, and co-supervises students involved in his research activities.

The committee also sponsors the student-organized Atlantic Universities Geological Conference (AUGC). It is the oldest geological student conference in Canada, which is organized entirely by the students. The student geology clubs from Acadia, Dalhousie, Memorial, University of New Brunswick, St. Francis Xavier and Saint Mary's universities take turns hosting the conference.

The 57th Annual AUGC was hosted by St. Francis Xavier University on October 26-28, 2006. The student organizing committee of the Faribault Geology Club was co-chaired by Sarah Hindle, Amanda Ehler, and Julia King. Organization was exceptional and everything went very smoothly. The conference started with a career workshop with presentations by Dr. Rick Secco, (University of Western Ontario), Michelle Miskell (Memorial), Coralie Charland and Ben Moulton (U Ottawa), Denise Hodder (Imperial Oil/Exxon Mobil, Canadian Society of Petroleum Geologists), and Mike MacDonald (Nova Scotia Department of Natural Resources).

On Friday, the conference included three one-day field trips: 1. Carbonate Hosted base metal mineralization at the Scotia Mine (led by Alan Anderson, St. F.X. University and Rick Horne, Nova Scotia Department of Natural Resources), 2. Mechanisms of Igneous Intrusion above Subduction Zones: The Greendale Complex, Antigonish Highlands, Nova Scotia (led by Brendan Murphy, St. F.X. University) and 3. Environmental Geology of Inverness County (led by Fred Baechler, ADI Ltd., Sydney Regional Office, and Grant Ferguson, St. F.X. University). The weather was excellent.

The main events of the final day were the undergraduate student talks and poster sessions (19 presentations in all), chaired by Sarah Hindle and Julia King, both 4th year students at St. Francis Xavier University. As usual, the standard of student presentations was first rate, and would grace any professional conference. All speakers and poster presenters were awarded a certificate from the Atlantic Geoscience Society which includes a year's membership and a subscription to the society journal *Atlantic Geology*. The panel of judges included: Howard Donohoe (retired, Nova Scotia Department of Natural Resources), Rick Secco (University of Western Ontario) and Mr. Aaron Grimeau (Devon Inc., Canadian Society of Petroleum Geologists). The Student-Industry Luncheon featured a presentation by Howard Donohoe on Professional Geoscience Registration.

The day ended with a banquet. The guest speaker was Allan Huard, a St. F.X. Alumnus of 1984 and a 1983 winner of the APICS award at this conference. He is currently the Senior Geologist - Brunswick Mine Exploration for Xstrata Zinc Canada. The APICS-NSERC award for the best scientific paper was given to Duncan McLeish from Dalhousie University for a talk entitled *Geology, Petrology and Metamorphic History of Western Algonquin Park: implications for the tectonic evolution of the Grenville Orogen*. The CSPG Trophy for the best presentation went to Daniel Haider from Dalhousie University for a presentation entitled *Petroleum Potential of the Mississippian Banff Formation*. Kristy-Lee Beal from the University of New Brunswick, who gave a talk entitled *The Zealand Station Beryl (Aquamarine) Deposit, West Central NB: Mineralogic, Geochronologic and Petrogenetic constraints* won the Frank Shea Memorial Award for the best paper dealing with Economic or Applied Geology. The PetroCanada award for the best presentation on Environmental Geology went to Erica Underwood, St. Francis Xavier University, for her presentation entitled "*Controls on the Barium Concentration in Groundwater*". The Imperial Oil Best Poster Award was awarded jointly to Peter Meredith, St. F.X. University for a presentation entitled "*An investigation of the chemical mobility and variability within a metamict zircon from the Georgeville Granite*" and to Kara-Lynn Scallion, Acadia University for "*Phosphate deposits in Cambrian Rocks of Avalonia in the Saint John New Brunswick area: Insight into Paleozoic Life?*"

The 58th Annual AUGC will be hosted by the University of New Brunswick in Fredericton from October 25-27, 2008. Mark it on your calendar!

ATLANTIC GEOLOGY EDITORS' REPORT 2007

The last printed issue of *Atlantic Geology*, volume 42#2/3, was mailed to subscribers in February 2007. It is a combined Special Issue (guest editors Don Fox, Mike Parsons, and Marcos Zentilli) on *Environmental Geoscience Research in the Atlantic Region*. It also includes the abstracts for the 2006 Newfoundland GAC section meeting and the 2006 AUGC.

Volume 43 (2007) is complete. It contains 12 papers and 3 sets of abstracts (AGS, NL section GAC, and AUGC) for a total of 209 pages, and hence is similar in size to previous volumes (e.g., v. 42 = 205 pages, v. 41 = 194 pages). The volume is not divided into issues, and papers and sets of abstracts were posted to the website during the year, as they became ready. Individual subscribers and those whose institutions are subscribers now can access v. 43 and all previous volumes of the journal back to v. 1. The on-line manuscript submission and reviewing process works smoothly and is comparable to that used by other journals.

Beginning with v. 44 (2008), Dr. Simon Haslett, Head of the Department of Geography at Bath Spa University, Bath, England, has become a fourth co-editor of *Atlantic Geology*. His appointment for a 3-year trial basis was approved in December by the AGS Council. Dr. Haslett plans to publicize the journal and solicit submissions in the UK and elsewhere in Europe, thus making the journal more "trans-Atlantic" in its scope.

The change to electronic publishing has resulted in a substantial decrease in publication costs as reflected in the financial report for the journal. It is too soon to know with certainty about the overall longer term financial status, as we still have some costs associated with v. 43 (printing and mailing of the paper copies for those who requested them and paid the associated extra charge). Hence it will be another year before we see the actual overall cost of operating an electronic journal, but current indications are that the income will exceed the costs.

We are grateful to Dr. Pierre Jutras of Saint Mary's University for providing translations of large parts of the text on the journal website. The OJS (Open Journal System) programme used by the Electronic Text Centre (ETC) at UNB to manage the website is not as adaptable to being bilingual as it initially appeared, but the ETC staff were very cooperative and put a lot of effort into making the site as bilingual as possible within the constraints of OJS. They have requested modifications of OJS for implementation in subsequent versions. In the meantime, they have been able to make the "home page" of the journal bilingual, and other pages in the French language side of the website have links to the translations prepared by Pierre.

The editors are grateful to Chris White for his important work as Production and Financial Manager of the journal. We thank the associate editors and other reviewers of manuscripts for their help, without which we would not have a high quality journal. We also thank authors for supporting the journal by submitting papers, and we always welcome manuscripts, as well as suggestions (and volunteer editors) for special issues.

Respectfully submitted by
Sandra Barr, Rob Fensome, and Ron Pickerill (co-editors)

ATLANTIC GEOSCIENCE SOCIETY, PRODUCTS COMMITTEE, REPORT 2007

The Products Committee reviewed and refined its procedures for considering funding applications by developing a standard “Proposal for Funding” form, now available from the AGS website. The committee received one completed funding request for an event, which it recommended to the Council. It has also received notification of intent for a proposal for a publication, the full details of which are under development