

S.04-25

SIMON FRASER UNIVERSITY
Senate Committee on University Priorities
Memorandum

TO: Senate

FROM: John Waterhouse
Chair, SCUP
Vice President, Academic

RE: Proposal for a Ph.D. Program in
Earth Sciences

DATE: March 1, 2004

At its February 4, 2004 meeting SCUP reviewed and approved the proposal from the Senate Graduate Studies Committee for the Ph.D. Program in Earth Sciences which is now forwarded to Senate.

Motion

That Senate approve and recommend to the Board of Governors the proposal for a Ph.D. in Earth Sciences, as set out in S.04-25

encl.

c: J. Driver
P. Mustard
G. Nicholls

SIMON FRASER UNIVERSITY

DEPARTMENT OF EARTH SCIENCES
<http://www.sfu.ca/earth-sciences/>



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A PROPOSAL FOR A PHD PROGRAM IN EARTH SCIENCES AT SIMON FRASER UNIVERSITY

1. Executive Summary

As a public university, it is the mandate of Simon Fraser University to provide a comprehensive set of educational and research opportunities for British Columbians at the undergraduate and graduate levels in all departments forming the University. The Department of Earth Sciences has rapidly become an important component of SFU's capacity to deliver training and research in the vital areas of environmental and geological sciences, complementing related activities elsewhere in the University, particularly in the Department of Geography, the School of Resource and Environmental Management, and the Department of Biological Sciences. The objective of the proposed doctoral program in the Department of Earth Sciences is to provide faculty and students with the opportunity to conduct research in all aspects of earth sciences at the most advanced level. As such, it will contribute to the advanced training of senior research scientists in the educational, governmental, and industrial sectors of the economy.

Introduction of this doctoral program completes the final phase of the implementation plan for establishing the Department of Earth Sciences at SFU. The Earth Sciences Program commenced operation in 1995 with an undergraduate program leading to a BSc in Earth Sciences. The graduate program was introduced in 1996 (MSc) and the Earth Sciences Program became a full Department in the Faculty of Science in 1999. The Department now has 14 faculty members including four full Professors, two of whom hold endowed research chairs (Forestry Renewal of British Columbia [FRBC]

Research Chair and Canadian Research Chair – Tier 1), five Associate Professors, three Assistant Professors, and two Lecturers. The Department is also in continued growth: two new Assistant Professors will be hired in 2003; a new building in construction on the Burnaby campus will host the Department in 2005; and a multi-million dollar Canadian Fund for Innovation application is under consideration for the creation of a Centre for Natural Hazard Research. The establishment of the doctoral program will also complete the University's obligation to provide a full departmental research environment (MSc and PhD) in which faculty research and the associated graduate student training at all levels in the Department of Earth Sciences can be conducted to its full potential.

2. Curriculum

- 2.1** Graduate students will develop further their skills as research scientists and will generate new significant knowledge in their chosen subfield of research.
- 2.2** The existing suite of graduate courses in the Department of Earth Sciences (see Appendix 1) and elsewhere within SFU and at sister institutions (under the Western Deans' Agreement) will meet the formal coursework requirements of the degree. New courses proposed for the new program, as well as representative course outlines can be found in Appendix 1.
- 2.3** The structure of the degree program reflects the central role of research and is identical to that mandated by the Faculty of Science at SFU for doctoral programs (see the proposed Calendar entry in Appendix 2). Class size for graduate courses will be small (1-5 students)
- 2.4** The doctoral program requires a doctoral thesis based on substantial original research.

3. Learning Methodologies

- 3.1** The doctoral program conforms to an apprenticeship model in which candidates will work in close collaboration with faculty who are established research scientists.
- 3.2** By its very nature, the PhD program will focus on independent research undertaken in formal association with an established faculty research

scientist. This scientist will head a supervisory group who will be the primary provider of the intellectual climate and physical resources for the student to function as a senior-scientist-in-training.

4. Faculty

- 4.1 The existing faculty complement in the Department of Earth Sciences at SFU numbers 12 research scientists supported by two teaching faculty and four other staff. As part of its continued growth, the Department is in the process of hiring two new tenure-track faculty positions. All current 12 Assistant, Associate and Full Professors have active NSERC-supported research programs involving the ongoing training of about 30 graduate students collectively. In addition, six research scientists provide support to the graduate program as Adjunct Professors. The qualifications of the research faculty who will be involved in the doctoral program are documented in Appendix 3.

5. Program Consultations and Evaluation

- 5.1 Full consultations with Provincial Universities, various government agencies, and professional associations were conducted when the Department of Earth Sciences was established and again when the BSc and MSc programs were introduced. No specific consultations have been conducted in relation to the proposed doctoral program.
- 5.2 The graduate program in the Department of Earth Sciences is administered by a Graduate Studies Committee which continuously monitors student progress and performance, graduation rates, and the post-degree employment profile. This committee operates in collaboration with the Faculty of Science Graduate Studies Committee and the Senate Graduate Studies Committee. The University has a set of standards and best practices defined in the Graduate General Regulations. University policies require the entire Departmental operation to be externally reviewed for performance every six years.
- 5.3 University policies require the processes noted in Section 5.2 to be continuing.

6. Admission and Transfer

- 6.1 Students applying for entrance into the PhD program normally must have completed BSc or MSc (or equivalent) degrees in Earth Sciences or acceptable degrees in Science or Engineering from recognized institutions. They must also satisfy the minimum requirements in SFU's

Graduate General Regulations, and be acceptable by the Earth Sciences Graduate Studies Committee. The minimum University requirements for admission to a doctoral program are as follows:

(a) either

a master's degree from a recognized university, or the equivalent,

or

a bachelor's degree, with a cumulative grade point average of at least 3.5, from a recognized university, or the equivalent,

or

completion of at least 75% of the course work credits required for the Department of Earth Sciences Master's programme, with a cumulative grade point average of at least 3.67. All graduate courses, whether taken at this University or another university, shall be considered in the calculation.

and

(b) submitted evidence that the applicant is capable of undertaking substantial original research. Normally, such capability will be judged from letters of reference from qualified referees, and the completion of a master's thesis or other scholarly work.

In addition, the student must satisfy any further requirements set by the graduate program committee. Students whose primary language is not English, may be required to satisfy the University and the graduate program committee that they have a command of the English language.

Residency requirement is 5 full-time semesters.

Under normal situations, transfer is not applicable. Acceptance of students transferring to SFU from another institution, or *vice versa*, is determined by individual departmental policy and identification of a willing senior supervisor. With prior approval, one half of the course requirements may be taken in another department or another institution.

7. Graduate Student Funding

- 7.1 Students will be admitted based on a commitment of full funding for up to 4 years by some combination of scholarships, fellowships, research assistantships, teaching assistantships, and direct funding from their supervisor's research funds. Presently, this level of graduate student funding in our department is typically in the \$15,000-20,000 range, although higher for some students receiving well-funded scholarships.
- 7.2 Students will normally only be accepted for admittance if there is a faculty member who has agreed to be the supervisor and the supervisor and

department have agreed to provide funding for the student through some combination of the funding sources listed in 7.1.

8. Other Additional Information

8.1 Target Student Audience & Program Character

The program targets MSc graduates who wish to pursue doctoral-level research in the Earth Sciences. We anticipate 2-5 students per year to enroll in the program, with an ongoing complement of 12-18 candidates on an annual basis.

Both UBC and UVic offer PhD programs in Earth Sciences or related fields. The proposed SFU PhD will provide increased research opportunities for B.C. geoscientists in the fields of geohazards, tectonics, and petroleum geology. The department has overlapping areas of expertise involving environmental geoscience (Quaternary geology and geomorphology, environmental hazards, engineering geology/forest geoscience, and groundwater hydrology), and additional strengths in continental tectonics, magmatism and metamorphism, geochemistry, basin analysis, sedimentology/facies analysis, and applied geophysics.

The normal time of completion of the PhD program is 12 semesters (4 years).

8.2 Labour Market and Student Demand

PhD graduates in Earth Sciences typically secure employment in one of four main areas: 1) University positions for professorships and lecturers, 2) post-doctoral research positions, 3) federal, provincial and territorial government geological agencies, and 4) private industry. Based on the American Geological Institute job postings, PhD graduates in Earth Sciences can expect approximately 820 permanent or temporary job positions to be offered annually across North America.

University positions: University postings for tenure professorships have been relatively steady at approximately 167 positions annually since 1998. Sessional and sabbatical replacements average 17 annually. These numbers are anticipated to increase over the next decade, due to the expected increase of retiring professors at several Canadian universities. Further, the National Science Foundation (NSF) has funded an average of 172 non-faculty research scientist positions/yr for the past 8 years.

Post-doc opportunities are significant, although precise numbers are difficult to ascertain, as many are posted through discussion groups or *via* word-of-mouth. NSF has funded an average of 445 post-doctoral

positions/yr for the last 8 years. In 1999, NSF granted 219 post-doctoral positions to appointees without US citizenship or permanent resident status. The Natural Science and Engineering Research Council (NSERC) has funded an average of 10 post-doctoral positions/yr over the last 3 years in Canada.

The Geological Survey of Canada employs some 229 PhD level geoscientists across Canada and has recruited approximately 10 PhD scientists/yr over the last 3 years.

Private industry has attracted a significant number of PhD graduates. The Association of Professional Engineers and Geoscientists of British Columbia (APEG BC) currently has 88 PhDs registered as Professional Geoscientists and 9 joint Professional Geoscientists /Professional Engineers in British Columbia. Industry areas of expertise include hydrogeology, environmental geology, petroleum geoscience, forestry, and mining.

A joint study in the United States by the American Geological Institute (AGI) and the American Geophysical Union (AGU) in 2001, surveyed 223 recent PhD graduates in Earth and Space Sciences. They found that more than 78% secured employment in the Earth Sciences. They also found that the unemployment rate of new PhD graduates in the geosciences was negligible and significantly below that of 2 years previous to the study. Over the past five years, the time to find employment decreased steadily. In 1998, PhD graduates spent an average 5.5 months looking for a job, while this number was only about 3.6 months after graduation in 2001. No comparable study has been conducted in Canada to our knowledge. The latest information from the Canadian Association of Graduate Studies indicate that there were 71 earth sciences PhD degrees awarded in 1998.

Currently, we have three students in PhD programs within the Department that have been accepted through "special arrangements". A fourth is expected shortly. Admission under special arrangements is restricted to exceptionally able applicants who wish to work for a doctoral degree outside or between existing programs at Simon Fraser University. This is not regarded to be a normal avenue for admission to a PhD program in the Faculty of Science. In addition, two of the existing professors, who are joint appointments with the Department of Geography, also provide PhD supervision through that department.

Faculty members of the Department routinely receive inquiries from students for information about enrolling in a PhD program in the Department. Within the last year alone there have been approximately 20 such inquiries. With the recent recruitment of a second research chair, this number is liable to increase markedly in the immediate future.

8.3 Continued Growth

The Department and the University are committed to the healthy growth of Earth Sciences at SFU. The Department is in the process of hiring two tenure track faculty positions at the Assistant Professor level. The first appointment will be in Petroleum Geology, with a focus on hydrocarbon exploration and reservoir evaluation. The second position is in Quaternary Geoscience or Engineering Geology, with a specialization in natural hazard research.

Simon Fraser University is currently planning the construction of a new building for Applied Science, which will host the Department of Earth Sciences. The expected date of completion of this new facility is September 2005.

The University will host the new Centre for Natural Hazard Research (CNHR), starting in 2005. The centre will be supported by a Canada Research Chair in Natural Hazards located in the Department of Earth Sciences. The CNHR will be the first of its kind in western Canada to conduct broad-based, innovative research on natural hazard processes, including earthquakes, tsunamis, volcanic eruptions, landslides, and floods. The Centre will have a strong component dedicated to the training of graduate students in the broad fields of natural hazard assessment and mitigation. The CNHR is a collaborative venture, involving scientists from Simon Fraser University, University of British Columbia, University of Victoria, University of Northern British Columbia, and University of Alberta.

APPENDIX 1

Existing & Proposed Earth Sciences Graduate Courses

Existing

EASC 600-1 Introduction to Graduate Studies

A required course designed to acquaint new graduate students with the research strengths of the program, research facilities in the University, and its vicinity. Procedures and policies relating to preparation, conduct and presentation of thesis research will be discussed. (seminar)

EASC 603-3 Field Techniques in Hydrogeology

This course is intended to complement the theoretical aspects of physical hydrogeology and aqueous geochemistry covered at an undergraduate (or early MSc) level by providing students with hands-on experience using hydrogeological equipment (data loggers, pumps, chemical sampling equipment), implementing sampling and testing protocols, and observing state-of-the-art monitoring and geophysical tools. The course entails preparatory research and data interpretation on the hydrogeology of the Fraser delta (including surficial geology, regional geochemistry and geophysical characteristics), a week at a hydrogeology field site on the Fraser River delta (early May), the extensive analysis and interpretation of data gathered during the field session complemented with regional data acquired during preliminary investigations, the development of a large-scale simulation model of the groundwater flow system at the site, and the completion of a comprehensive hydrogeological report. The course normally runs for about three weeks following spring session final examinations. Note: This course has limited enrollment. (2-0-2) Prerequisite: undergraduate courses in physical and chemical hydrogeology (or equivalent) and consent of the department.

EASC 604-3 Deformation Mechanisms and Continental Tectonics

This course will focus on increasing the level of understanding of the mechanisms by which rocks deform and the effect of environmental variables (effective pressure, temperature, strain rate, chemical environment, etc.) on these deformation mechanisms. Lectures will cover flow concepts applied to ductile deformation, grain-scale to crustal-scale strain partitioning, and models of exhumation of metamorphic rocks. The link between far-field effects such as lithosphere rheology, climate and erosion, and orogenic style will also be discussed. Prerequisite: EASC 204 and EASC 309 (or with permission of the instructor). (2-0-2).

EASC 606-3 Advanced Field Methods in Earth Sciences

Focuses mainly on the field description, measurement and interpretation of geological, geochemical and geophysical features, and may concentrate on certain aspects of bedrock or surficial geology. Includes methods of data acquisition, display and modeling. Field exercises may be augmented by directed readings and laboratory studies. Course costs depend on the location and duration of field work and the nature of related investigations. Prerequisite: permission of the instructor. (2-0-2)

EASC 607-3 Exploration Seismology

Application of seismic methods of the delineation of hydrocarbon deposits and crustal structure. Travel time expressions for a layered Earth; Zoeppritz' equations; 2-D and 3-D seismic surveying methods; reflection data processing, including deconvolution and migration; amplitude versus offset methods and direct hydrocarbon detection; seismic wave propagation in Earth's crust; refraction inversion; principles of seismic interpretation. (2-0-2) Prerequisite: EASC 417 or equivalent.

EASC 608-3 Advanced Metamorphic Petrology

Field relations, nature and origin of metamorphic and metasedimentary rocks, graphical treatment and interpretation of mineral assemblages and heat-flow regimes in the framework of global tectonics, with special emphasis on derivation of pressure-temperature-fluid conditions ranging from low-grade rocks through granulites to partial melts. Laboratory: petrographic techniques applied to the study of rock suites. Prerequisite: permission of the instructor. (202)

EASC 611-3 Sedimentology

An advanced treatment of topics which may include processes of sedimentation, facies model concepts, applications of ichnology, and depositional environments with an emphasis on siliciclastic successions. Course content will be tailored to student interest, but generally will include both non-marine and marine processes of sedimentation and resultant depositional systems. The development of effective field criteria for the interpretation of the sedimentary record will be emphasized. (2-0-2)

EASC 612-3 Stratigraphy

Stratigraphic concepts of lithostratigraphy, biostratigraphy, chronostratigraphy and genetic stratigraphy. The course concentrates on genetic stratigraphy, with emphasis on allostratigraphy, genetic stratigraphic sequences and sequence stratigraphy. Students will critically assess each paradigm and its applicability to both the subdivision and the interpretation of the sedimentary record. Relative sea level changes and their effects on deposition will be discussed in relation to the preserved sedimentary record. Students will examine the utility of facies analysis in the various genetic stratigraphic frameworks and the viability of reconstructing the depositional history of sedimentary successions. (2-0-2)

EASC 613-3 Groundwater Hydrology

Advanced topics in physical hydrogeology, including fluids and porous media, saturated and unsaturated flow systems, mass transport and dispersion, and hydrogeological modeling. The course includes an introduction to numerical techniques for groundwater modeling, focusing on the understanding of fundamental principles and an appreciation of the role of models. The course assumes successful completion of at least one undergraduate hydrogeology course. (2-0-2)

EASC 614-3 Subsurface Techniques

Advanced topics in subsurface exploration methods. Methods of drilling; core description and analysis; well logging. (1-0-3)

EASC 615-3 Applied Geophysics

Instrumentation, application and limitations of electrical, seismic, radar and gravity methods in the exploration for mineral resources and in engineering applications. (1-0-3)

EASC 616-3 Fluvial Systems

Fluid mechanics of open channel flow; physical sedimentology and sediment transport in aqueous environments. (2-0-2). Prerequisite: appropriate standing in Applied Mathematics and in Physics.

EASC 617-3 Quaternary Geology

Environments of glacial and proglacial deposits. Quaternary stratigraphy and dating methods with emphasis on the Cordillera. (1-0-3)

EASC 618-3 Tectonics of Sedimentary Basins

Regional processes of subsidence and basin formation from a plate tectonics viewpoint. The course will examine the origins and general characteristics of convergent, divergent, intraplate and hybrid basins. Methods of discriminating basin origins from an understanding of depositional systems, stratigraphic analysis, provenance and compositional variations will be examined. (2-0-2)

EASC 619-3 Environmental Geoscience

An examination of the concepts, methods and techniques used in advanced case studies of environmental geology, in fields including forestry, environmental geochemistry, earthquake and volcanic hazard, and urban planning. (2-0-2)

EASC 620-3 Volcanology

Physical, chemical and tectonic aspects of volcanology examined with emphasis on processes of magma generation and evolution, styles of eruption, environments of deposition, and interpretation of volcanic facies. (2-0-2) Prerequisite: undergraduate course in petrology and structural geology.

EASC 621-3 Tectonics and Magmatism of Convergent Plate Margins

Geological processes at convergent plate margins are considered in the context of plate tectonic principles. Topics to be addressed include: driving forces of tectonic plates, mantle convection, geometry of subducted slabs, ridge-trench intersections, generation of volcanic arcs, causes of anomalous magmatism, accretion of terranes, and transpression of orogenic belts. (2-0-2) Prerequisite: undergraduate structural geology and petrology courses.

EASC 622-3 Principles of Ichnology

The conceptual framework of ichnology with particular emphasis on the ethological (behavioral) classification of biogenic structures, as well as its applications to the ichnofacies concept and paleoenvironmental interpretation of the sedimentary record. Environmental stresses and organism responses will be integrated with conventional sedimentology to highlight the complex inter-relationships between infauna and the environments they inhabit. The genetic stratigraphic applications of ichnology will also be addressed. (2-0-2) Prerequisite: advanced undergraduate sedimentology course

EASC 623-3 Groundwater Resource Evaluation

In addition to examining groundwater resources (exploration, evaluation and management), this course expands upon the theory and use of aquifer tests and their respective methods of analysis for evaluating groundwater resources. Advanced methodologies for partially penetrating wells, leaky aquifers, anisotropic aquifers, double porosity type and fractured aquifers will be included. Computer applications will be emphasized. (2-0-2) Prerequisite: undergraduate course in groundwater.

EASC 701-1 Special Topics in Earth Sciences

EASC 702-2 Special Topics in Earth Sciences

EASC 703-3 Special Topics in Earth Sciences

EASC 704-3 Special Topics in Earth Sciences

EASC 705-3 Special Topics in Earth Sciences

EASC 706-3 Special Topics in Earth Sciences

EASC 707-3 Special Topics in Earth Sciences

EASC 708-3 Special Topics in Earth Sciences

EASC 709-1 Directed Readings

EASC 710-2 Directed Readings

EASC 711-3 Directed Readings

New Courses in the process of being approved

NOTE: Both courses approved by Senate at its meeting on Oct 6, 2003

EASC 624-3 Geology of the Canadian Cordillera

EASC 625-3 Issues in Canadian Cordillera Geology and Tectonics

Proposed Course Numbers for PhD Program

EASC 900-1 PhD Research Seminar I

EASC 901-1 PhD Research Seminar II

EASC 998-6 PhD Thesis

Representative Course Outlines

EASC 604-3 Deformation Mechanisms and Continental Tectonics

Instructor: Dr. L. Godin

General

This course will focus on increasing the level of understanding of the mechanisms by which rocks deform and the effect of environmental variables (effective pressure, temperature, strain rate, chemical environment, etc.) on these deformation mechanisms. Lectures will cover flow concepts applied to ductile deformation, grain-scale to crustal-scale strain partitioning, and models of exhumation of metamorphic rocks. The link between far-field effects such as lithosphere rheology, climate and erosion, and orogenic style will also be discussed.

Course Topics

- Deformation mechanisms and deformation maps
- Flow concepts and ductile deformation
- Microstructures and petrofabrics
- Strain partitioning in contractional, extensional, and transcurrent settings
- Rheology and Tectonics
- Exhumation of Metamorphic Rocks
 - Channel-flow and General shear extrusion
 - Prowedge and retrowedge tectonics
 - The role of Climate
- Evolution of mountain belts through time
- Case-studies in contractional, extensional and transcurrent settings

Prerequisites

Undergraduate level courses in Structural Geology and Global Tectonics, equivalent to EASC 204 and EASC 309 (or permission of the instructor).

Course structure

There will be one two-hour lecture each week, followed by class discussions on selected readings. There will be some practical sessions to illustrate concepts as needed. The students will have to do a term paper/project on a topic to be decided with the instructor, as well as a seminar to be presented toward the end of the term.

Textbook

There are no required texts – But seriously consider buying:

Microtectonics, C. W. Passchier & R. A. J. Trouw. 1996. Springer-Verlag. 289 p.

Shear-sense Indicators: A Review, by S. Hanmer & C. Passchier, 1991. Geological Survey of Canada Paper 90-17, 72 p.

Readings will be from numerous textbooks and scientific journals available at the library

Course Grading

<i>Participation in weekly discussions:</i>	20%
<i>Term Paper & Seminar:</i>	40%
<i>Final Oral examination:</i>	40%

EASC 611-3 Advanced Sedimentology - Facies Analysis

Instructor: Dr. J.A. MacEachern

General:

This course is an advanced treatment of facies characteristics and interpretation, facies model concepts, applications of ichnology to depositional environment interpretation with an emphasis on siliciclastic successions, and genetic stratigraphic applications to facies analysis. Course content will include terrestrial, marginal marine and marine environments, in both siliciclastic and carbonate depositional settings. The development of effective field criteria for the interpretation of the sedimentary record will be considered. The ethological (behavioural) classification of biogenic structures, as well as their applications to the ichnofacies concept and to paleoenvironmental interpretation of the sedimentary record will be considered. Students will examine the utility of facies analysis in the various genetic stratigraphic frameworks and the viability of reconstructing the depositional history of sedimentary successions. Relative sea level changes and their effects on deposition will be discussed in relation to the preserved sedimentary record.

Course Topics:

1. Facies Characteristics and Paleoenvironmental Interpretation.
2. Facies Model Concepts for Siliciclastic and Carbonate Successions.
3. Ichnology and Sedimentary Facies Analysis.
4. Genetic Stratigraphy and Relative Sea Level Changes.

Course Organization:

One 2 hour lecture/seminar per week.

One 2 hour laboratory session per week. Some field trips.

Note: One field trip is to Salt Spring Island for a weekend and is estimated to cost ~\$125 including food, transport and accommodation.

Course Textbook:

Reading. H.G., 1996, Sedimentary Environments and Facies: Processes, Facies and Stratigraphy, 3rd edition: Blackwell Scientific Publishing, 688p.

In addition, course note material, reading lists and papers not available from the library will be provided in class.

Prerequisites:

EASC 201, and EASC 302 or permission of the instructor.

Grading:

- | | |
|--------------------------|-----|
| 1. Seminars | 10% |
| 2. Seminar Participation | 5% |
| 3. Term Paper | 25% |
| 4. Field Trip Reports | 10% |
| 5. Laboratory Project | 20% |
| 6. Final Exam | 30% |

EASC 613-3 Groundwater modelling

Instructor: Dr. D. M. Allen

General:

Groundwater Modelling is an introduction to hydrogeological modelling. The course will provide the student with the relevant theory and practical experience to develop and test conceptual models, to recognize data requirements, and to identify the limitations of numerical models. Assignments and a term project will be completed using state-of-the-art groundwater modelling software. An emphasis is placed on modelling flow in the saturated zone, but unsaturated zone hydrology, solute transport, and density dependent flow are also covered.

Prerequisites: EASC 304 (or equivalent) and permission of instructor

Course Topics:

1. Review of Fundamentals in Hydrology/Hydrogeology
2. Groundwater Modelling
 - a) Introduction to Numerical Modelling
 - b) Conceptual Models and Grid Design
 - c) Boundaries / Sources and Sinks
 - d) Transient Simulations
 - e) Model Execution and Calibration
 - f) Documenting a Study
3. Particle Tracking - Flow System Analysis, Capture Zones
4. Introduction to Solute Transport
5. Groundwater Flow in the Unsaturated Zone
6. Advanced Topics - Fracture Flow, Multi-Phase Flow, Density Dependent Flow

The following computer codes will be used:

- I. 2-D Flow Modelling: **FLOWPATH**
- II. 2-D Cross-Sectional Flow and Transport Modelling: **FLOTRANS**
- III. 3-D Flow and Particle Tracking : **Visual MODFLOW**
- IV. 3-D Solute Transport: **MT3D**
- V. 1-D Unsaturated Flow and Contaminant Transport: **WHI UnSat Suite**

Textbook:

Anderson, M.P. and Woessner, W.W. 1992. *Applied Groundwater Modeling: Simulation of Flow and Advective Transport*, Academic Press, Inc. 381 pp.

Course Grading:

- | | |
|----------------------|-----|
| 1. Assignments | 60% |
| 2. Modelling Project | 40% |

EASC 616-3 Rivers: Environments and Engineering

Instructor: Dr. E. J. Hickin

Course Description

EASC 616 is a course in fluid mechanics and sediment transport physics as applied to open-channel flow in rivers. This course may be deemed equivalent to APEGBC Course 94-GT-B11 (Fluid Mechanics) or 94-GT-B24 (Advanced Course in Geoscience).

Course topics:

- Review of basic fluvial geomorphology
- 1. Review of dimensions; measurement precision and accuracy; dimensional analysis.
- 2. Properties of flowing water: statics, viscosity, laminar and turbulent flow; velocity profile & stress/strain relations; Reynolds number. Flow lines.
- 3. The energy equation: Bernoulli; specific energy, Froude number, subcritical and supercritical flow transitions, choking, engineering problems/solutions.
- 4. The momentum-impulse equation; the hydraulic jump; engineering problems/solutions.
- 5. The nature of turbulent flow, coherent flow structures.
- 6. Universal velocity equations for flow over smooth and rough boundaries; point shear stress determination.
- 7. Flow resistance; Chezy C, Mannings n, D'Arcy Weisbach coefficient, engineering problems/solutions.
- 8. Sediment transport theory: physics of settling velocity and grain suspensions in fluids; physics of incipient motion, Shields parameter, bedload transport equations; engineering problems/solutions.
- 9. Channel morphology: the form/process linkage: threshold hydraulic geometry.
- 10. Paleoflow reconstruction and sedimentology

Prerequisites: EASC 201, GEOG 313, MATH 152 and PHYS 121 or permission of the Instructor.

Textbook: There is no textbook for this course; a comprehensive set of course notes will be distributed in the first class.

Grades will be based on (a) Class assignments/seminars: 40% (b) In-term examinations (2): 60%

There will be labs in the first week of classes. For further information contact the Instructor, Professor Ted Hickin: Room P9312 (in the Earth Sciences Complex); Phone: 291 4657; Email: hickin@sfu.ca

EASC 618-3 Tectonics of Sedimentary Basins

Instructor: Dr. P. S. Mustard

General:

Regional processes of subsidence and basin formation from a plate tectonics viewpoint. The course will examine the origins and general characteristics of convergent, divergent, intraplate and hybrid basins. Methods of discriminating basin origins from an understanding of depositional systems, stratigraphic analysis, provenance and compositional variations will be examined. This will be organized around a single 2-3 hour / week time slot which we will pick in the first week of classes. The course will comprise seminars by the instructor and students and maybe some guests. Expect a considerable "reading" list as part of this course (but "skimming intelligently" is really what we will do!)

Prerequisites: permission of instructor, EASC 309 or equivalent, EASC 402 or equivalent recommended.

Textbook (optional): *Tectonics of Sedimentary Basins*, 1995, edited by C.J. Busby and R.V. Ingersoll, Blackwell Scientific, 579 p. (not available at bookstore; we will order copies in first week for those who want one)

Grading:

- Seminars (2): 40% total
- Term Papers (2): 40% total
- Class discussion/participation: 20%

EASC 624-3 GEOLOGY OF THE CANADIAN CORDILLERA

Instructor: Dr. P. S. Mustard

Note: This graduate course will be held in conjunction with the undergraduate course EASC 408. Graduate students will complete a similar component of course material to that of the undergraduates. However, seminar and term paper topics will be at a more advanced level compared to that expected for undergraduate students in the companion course.

Why study the geology of western Canada's mountains?

The region is a natural laboratory containing "hands-on" examples of features and processes pertaining to most facets of the Earth Sciences, supported by a wealth of readily available geological, geochemical and geophysical data. From a global perspective, interpretation of the evolution of the region provides a model for the way in which new continental crust probably was and is being formed from mostly intra-oceanic and/or isotopically juvenile material.

What region is covered?

The mountains of western Canada, formally known as Canadian Cordillera, are the focus of the course. Flanking regions (the prairies to the east, and the Pacific Ocean floor to the west) will be discussed insofar as they relate to the Canadian Cordillera, as will along-strike segments in the United States.

Course outline

- I. Introduction: review of background material of use in deciphering Canadian Cordilleran geology.
- II. Physiography and active tectonics of the Canadian Cordillera.
- III. Description and discussion of rocks, stratigraphy, structure, tectonics, and mineral deposits within the framework of the five traditional morphogeological belts of the Canadian Cordillera, from east to west, the (1) Foreland; (2) Omineca; (3) Intermontane; (4) Coast; and (5) Insular belts.
- IV. Setting of the Canadian Cordillera in North American and world geology.
- V. Summary and synthesis: the tectonic evolution of the Canadian Cordillera.

Prerequisites: An undergraduate background that includes courses at any level in structural geology, plate tectonics, geochemistry, geophysics, petrology (sedimentary, metamorphic, and igneous), plus permission from the instructor

Course Grading

Midterm Exams:	15%
Lab Exercises:	20%
Term Paper	12.5%
Seminar Presentation	12.5%
Final Exam:	40%

Text material

There is no formal text, although you will need the Tectonic Assemblage Map of the Canadian Cordillera (Wheeler and McFeely, 1991, Geological Survey of Canada (GSC), Map 1712A), which costs \$32 plus tax and is available from the GSC bookstore at 605, Robson Street, Vancouver.

Field trip

Participation in a field trip is a required parts of the course. The field trip will be held during one of the later weekends in March, possibly requiring a late Friday afternoon start.. It will be either a circle traverse of the south central Cordillara, or a full Calgary to Vancouver transect

Field Trip Fee: a \$50 field trip fee will be collected to cover transportation and misc. expenses for the trip but not food. Students should budget about \$50-75 in extras expenses for this trip.

EASC 625-3 Canadian Cordillera Geology and Tectonics

Instructor: Dr. P. S. Mustard

Course Outline

The Canadian Cordillera represents a world-class example of an "accretionary orogen", where new continental crust is in the process of formation. It also preserves a partial record of a 2 billion year plus history of tectonic reorganization, with evidence of complex periods of supercontinent amalgamation, dispersal, and deformation. Understanding this orogenic belt requires a broad knowledge of both the historically important research from which our current paradigm has developed (mostly paralleling our understanding of the processes of plate tectonics), and the current "hot trends" and contentious areas of debate about how this margin has developed.

This course will be organized around a single 3 hour / week time slot, which we will pick in the first week of classes. The course will comprise seminars by the instructor and students and probably some guest experts. Topics for discussion will be tailored to some extent to the research interests and geologic background of the students taking the course, although students should expect to also be challenged to learn outside of their main field of interest. Expect a considerable "reading" list as part of this course (but "skimming intelligently" is really what we will do!). If there is sufficient interest and relevance, one or more one to three day field trips may be conducted as part of this course.

Prerequisites:

An undergraduate background that preferably includes courses at any level in structural geology, plate tectonics, geochemistry, geophysics, petrology (sedimentary, metamorphic, and igneous). This background will be assessed by the instructor, whose specific permission must be obtained before registration.

Textbook:

None; however, expect a substantial reading list of journal articles, etc.

Grading:

- Seminars (2): 40% total
- Term Papers (2): 40% total
- Class discussion/participation: 20%

Simon Fraser University

New Graduate Course Proposal Form

Department: EARTH SCIENCES Course Number: EASC 900-1

Course Title: PHD RESEARCH SEMINAR

Course Description for Calendar (append a course outline):

Credit Hours: 1 Vector: Seminar Prerequisites (if any): Registration in PhD program

Estimated Enrollment: 3 When the course will first be offered: 2005-03

Frequency of course offering: Every semester

Justification:

This course provides the student with the opportunity to present an Earth Sciences topic approved by his/her supervisory committee in an oral format to a wide audience. One of the two seminars (EASC 900-1 or 901-1) required by the EASC PhD program must be based on completed or nearly completed thesis work.

Resources:

Faculty member(s) who will normally teach this course: ALL
(append information about their competency to teach this course)

Number of additional faculty members required in order to offer this course: 0

Additional space required in order to offer this course (append details): N/A

Additional specialized equipment required in order to offer this course (append details): N/A

Additional Library resources required (append details): annually: \$ 0.00
one-time: \$ 0.00

Any other resource implications of offering this course (append details): NONE

If additional resources are required to offer this course, the department proposing the course should be prepared to provide information on the source(s) of those additional resources.

Approvals:

Departmental Graduate Program Committee: _____ Date: _____

Faculty Graduate Studies Committee: _____ Date: _____

Faculty: _____ Date: _____

Following approval by the Faculty, this form and all relevant documentation should be forwarded to the Assistant Director – Graduate Studies in the Office of the Registrar for consideration by the Senate Graduate Studies Committee, the Senate Committee on Academic Planning and the Senate.

SIMON FRASER UNIVERSITY
NEW GRADUATE COURSE APPROVAL COVER SHEET
ATTACHMENT TO NEW GRADUATE COURSE APPROVAL FORM

Departmental approval indicates that a Department has approved the content of the course, and has consulted with other Departments and Faculties regarding proposed course content and overlap issues. Non-departmentalized Faculties should complete both sections B and C. **All approvals are signified by appropriate signature and date.**

A. Other Departments and Faculties that have been consulted regarding the proposed course content, including overlap issues. For each consultation indicate approval/disagreement. Add more pages if necessary.

B. Course approval by Department Graduate Program Committee

C. Faculty approval. Other Faculties' approval indicates that the dean(s) or designate(s) of other Faculties affected by the proposed new course support(s) the approval of the new course. **All approvals are signified by appropriate signature and date.**

Home Faculty approval indicates that all the necessary course content and overlap concerns have been resolved, and that the Faculty/Department commits to providing the required Library funds

Other Faculties' approvals _____

D. Outstanding resource issues to be addressed prior to implementation : space, laboratory equipment etc.

E. SGSC approval indicates that the course has been approved for implementation subject, where appropriate, to financial issues being addressed. **Approvals is signified by appropriate signature and date.**

Simon Fraser University
New Graduate Course Proposal Form

Department: EARTH SCIENCES Course Number: EASC 901-1

Course Title: PHD RESEARCH SEMINAR

Course Description for Calendar (append a course outline):

Credit Hours: 1 Vector: Seminar Prerequisites (if any): Registration in PhD program

Estimated Enrollment: 3 When the course will first be offered: 2005-03

Frequency of course offering: Every semester

Justification:

This course provides the student with the opportunity to present an Earth Sciences topic approved by his/her supervisory committee in an oral format to a wide audience. One of the two seminars (EASC 900-1 or 901-1) required by the EASC PhD program must be based on completed or nearly completed thesis work.

Resources:

Faculty member(s) who will normally teach this course: ALL
(append information about their competency to teach this course)

Number of additional faculty members required in order to offer this course: 0

Additional space required in order to offer this course (append details): N/A

Additional specialized equipment required in order to offer this course (append details): N/A

Additional Library resources required (append details): annually: \$ 0.00
one-time: \$ 0.00

Any other resource implications of offering this course (append details): NONE

If additional resources are required to offer this course, the department proposing the course should be prepared to provide information on the source(s) of those additional resources.

Approvals:

Departmental Graduate Program Committee: _____ Date: _____

Faculty Graduate Studies Committee: _____ Date: _____

Faculty: _____ Date: _____

Following approval by the Faculty, this form and all relevant documentation should be forwarded to the Assistant Director – Graduate Studies in the Office of the Registrar for consideration by the Senate Graduate Studies Committee, the Senate Committee on Academic Planning and the Senate.

SEMON FRASER UNIVERSITY
NEW GRADUATE COURSE APPROVAL COVER SHEET
ATTACHMENT TO NEW GRADUATE COURSE APPROVAL FORM

Departmental approval indicates that a Department has approved the content of the course, and has consulted with other Departments and Faculties regarding proposed course content and overlap issues. Non-departmentalized Faculties should complete both sections B and C. **All approvals are signified by appropriate signature and date.**

A. Other Departments and Faculties that have been consulted regarding the proposed course content, including overlap issues. For each consultation indicate approval/disagreement. Add more pages if necessary.

B. Course approval by Department Graduate Program Committee

C. Faculty approval. Other Faculties' approval indicates that the dean(s) or designate(s) of other Faculties affected by the proposed new course support(s) the approval of the new course. **All approvals are signified by appropriate signature and date.**

Home Faculty approval indicates that all the necessary course content and overlap concerns have been resolved, and that the Faculty/Department commits to providing the required Library funds

Other Faculties' approvals _____

D. Outstanding resource issues to be addressed prior to implementation : space, laboratory equipment etc.

E. SGSC approval indicates that the course has been approved for implementation subject, where appropriate, to financial issues being addressed. **Approvals is signified by appropriate signature and date.**

Simon Fraser University
New Graduate Course Proposal Form

Department: EARTH SCIENCES Course Number: EASC 998-6

Course Title: PHD THESIS

Course Description for Calendar (append a course outline):

Credit Hours: 6 Vector: _____ Prerequisites (if any): Registration in PhD program

Estimated Enrollment: 3 When the course will first be offered: 2005-03

Frequency of course offering: Every semester

Justification:

Every student registered in the Earth Sciences PhD program is required to undertake original research, which must be presented in a thesis and defended before an examining committee.

Resources:

Faculty member(s) who will normally teach this course: ALL
(append information about their competency to teach this course)

Number of additional faculty members required in order to offer this course: 0

Additional space required in order to offer this course (append details): N/A

Additional specialized equipment required in order to offer this course (append details): N/A

Additional Library resources required (append details): annually: \$ _____
one-time: \$ _____

Any other resource implications of offering this course (append details): NONE

If additional resources are required to offer this course, the department proposing the course should be prepared to provide information on the source(s) of those additional resources.

Approvals:

Departmental Graduate Program Committee: _____ Date: _____

Faculty Graduate Studies Committee: _____ Date: _____

Faculty: _____ Date: _____

Following approval by the Faculty, this form and all relevant documentation should be forwarded to the Assistant Director – Graduate Studies in the Office of the Registrar for consideration by the Senate Graduate Studies Committee, the Senate Committee on Academic Planning and the Senate.

SIMON FRASER UNIVERSITY
NEW GRADUATE COURSE APPROVAL COVER SHEET
ATTACHMENT TO NEW GRADUATE COURSE APPROVAL FORM

Departmental approval indicates that a Department has approved the content of the course, and has consulted with other Departments and Faculties regarding proposed course content and overlap issues. Non-departmentalized Faculties should complete both sections B and C. **All approvals are signified by appropriate signature and date.**

A. Other Departments and Faculties that have been consulted regarding the proposed course content, including overlap issues. For each consultation indicate approval/disagreement. Add more pages if necessary.

B. Course approval by Department Graduate Program Committee

C. Faculty approval. Other Faculties' approval indicates that the dean(s) or designate(s) of other Faculties affected by the proposed new course support(s) the approval of the new course. **All approvals are signified by appropriate signature and date.**

Home Faculty approval indicates that all the necessary course content and overlap concerns have been resolved, and that the Faculty/Department commits to providing the required Library funds

Other Faculties' approvals _____

D. Outstanding resource issues to be addressed prior to implementation : space, laboratory equipment etc.

E. SGSC approval indicates that the course has been approved for implementation subject, where appropriate, to financial issues being addressed. **Approvals is signified by appropriate signature and date.**

APPENDIX 2 PhD Program Calendar Entry

Department of Earth Sciences

P9304 Shrum Science Centre, (604) 291-5387 Tel, (604) 291-4198 Fax, www.sfu.ca/earth-sciences

Chair

D. Stead BSc (Exeter), MSc (Leeds), PhD (Nottingham)

Graduate Program Chair

P. S. Mustard BSc (Calgary), MSc, PhD (Carleton), PGeo

Faculty and Areas of Research

See Department of Earth Sciences for a complete list of faculty.

D.M. Allen - Hydrogeology

A.J. Calvert - Geophysics

J.J. Clague - Geologic hazards and Quaternary geology

L. Godin - Structural geology and continental tectonics

E.J. Hickin - Fluvial geomorphology and sedimentology

J.A. MacEachern - Ichnology, sedimentology and stratigraphy

D. Marshall - Geochemistry, metamorphic petrology, and ore deposits

P.S. Mustard - Evolution of sedimentary basins

M.C. Roberts - Quaternary depositional environments

D. Stead - Engineering geology, rock mechanics, forestry geoscience

D.J. Thorkelson - Magmatism and tectonics

B.C. Ward - Quaternary and Environmental geology

New Faculty (2003) - Petroleum Geology

New Faculty (2003) - Quaternary Geoscience/ Engineering Geology

PhD Program

See the "Graduate General Regulations" section 1.3.4 for minimum University requirements for admission to a doctoral program.

Students whose primary language is not English may be required to demonstrate an adequate command of English to the university and the graduate program committee. (See also section 1.3.12).

Transfer from the Master's Program to the PhD Program

Students accepted to the PhD program will normally have completed a master's degree in Earth Sciences or an acceptable master's degree in Science or Engineering. However, a student without a master's degree may be admitted to the PhD program after at least 12 months in the MSc program, if: 1) they have completed at least 75% of the course work credits required for the

Master's program with a cumulative grade point average of at least 3.67, 2) the student has shown outstanding potential for research, and 3) the student's supervisory committee, departmental graduate program committee, and senate graduate studies committee grant approval.

Course Work

For students entering with a BSc or equivalent: 15 credit hours of graduate courses in addition to EASC 600, 900, 901 and 998. For students entering with a master's degree: six credit hours of graduate courses in addition to EASC 600, 900, 901 and 998. Courses should be chosen from the list below, or with the graduate chairs approval, from related graduate courses in other departments including Physical Geography, Chemistry, Physics, Biological Sciences, and Resources and Environmental Management. Course selections will include no more than six credit hours from 700 level EASC courses. Students must maintain a 3.0 CGPA in course work (section 1.5.1 of the Graduate General Regulations). Failure to do so is taken as evidence of unsatisfactory progress (section 1.5.4 of the Graduate General Regulations).

With advance approval, a PhD student may take up to one-half of the above course requirement at another university for credit toward the PhD degree at Simon Fraser University.

Additional course work may be assigned by the supervisory committee, based on the results of the Oral Candidacy Examination.

In addition to their normal course work, PhD students must present two research seminars (EASC 900 and EASC 901). At least one of these seminars should be based on completed or nearly completed thesis work. One seminar may address any Earth Sciences topic approved by the supervisory committee. PhD students are expected to attend all the research seminars in the department.

Oral Candidacy Examination

Every PhD graduate student in the Department of Earth Sciences must complete an Oral Candidacy Examination prior to the end of the fourth semester of registration, or in the first semester after transferring from the MSc program. The candidate must submit a written thesis proposal to the supervisory committee and present it at the beginning of the Oral Candidacy Examination, which will be followed by an oral examination. The student must demonstrate an ability to conduct independent research, and have a sufficient command of the studied discipline to explain the research proposal and defend it. The Oral Candidacy Examination must be successfully completed prior to undertaking any significant thesis research.

The Oral Candidacy Examination concentrates on the student's major area of research and two minor areas, as agreed upon by the supervisory committee and the student. The examination is graded satisfactory/unsatisfactory by an examining committee consisting of the supervisory committee and one member external to the committee. Students with an unsatisfactory grade must pass a second exam within six months; a student receiving a second unsatisfactory rating will be required to withdraw from the program.

Thesis

Students define and undertake original research, the results of which are reported in a thesis and defended before an examining committee (section 1.9.3 of the Graduate General Regulations). Students must conform to residence requirements (1.7.3 of the Graduate General Regulations).

The program will normally be completed in 12 semesters (4 years) and not more than 15 semesters (5 years).

The student's progress will be reviewed every 12 months by a supervisory committee consisting of three or more faculty members (as per section 1.8.1 of the Graduate General Regulations). The senior supervisor will be an Earth Science faculty member approved by the department's graduate program committee. At each annual review, the student presents a summary of his/her work to date, with the first review being the Oral Candidacy Examination, when the Thesis Proposal is to be presented. Students not making satisfactory progress in their research, or failing to demonstrate satisfactory knowledge and understanding of recent publications in their general area of research, or failing to have their revised research proposal approved by the supervisory committee within 18 months of admission may be required to withdraw as per section 1.8.2 of the Graduate General Regulations.

Appendix 3

Department of Earth Sciences Faculty Curriculum Vitae, 1997-2002

1. Dr Diana Allen, Associate Professor (hydrogeology)

1.1 Educational Background

1996 Ph.D. Earth Sciences / Hydrogeology, Carleton University, Canada

Steady-state and Transient Hydrologic, Thermal and Chemical Modelling of a Faulted Carbonate Aquifer used for Aquifer Thermal Energy Storage, Carleton University, Ottawa, Canada.

1988 M.Sc. Earth Sciences / Permafrost, Carleton University, Canada

The Permafrost Regime in the Mackenzie Delta-Beaufort Sea Region, N.W.T. and its Paleoclimatic Implications

1986 B.Sc. Honours Geology and Physics, Carleton University, Canada

An Analysis of the Occurrence of Permafrost in the Mackenzie Delta - Beaufort Sea Region, N.W.T.

1.2 Current Research Interests

The main focus of my research program is directed at characterizing aquifers and studying geological and environmental processes in aquifers through the use of geological and hydrogeological techniques, geophysics, geochemistry (major and stable isotope), and numerical modelling. Projects have included studying the evolution of groundwaters on the Gulf Islands, saltwater intrusion mechanisms in fractured rock aquifer, scale dependence in hydraulic test data collected near fault zones, sensitivity of aquifers to climate change, groundwater-surface water interactions. New and planned research include modelling the hydrogeology of islands following glacial rebound to provide estimates of recharge and to investigate mechanisms of saltwater intrusion in fractured bedrock aquifers and developing a classification scheme for vulnerability mapping of fractured aquifers [hydraulic testing, saltwater intrusion, numerical modelling, climate change, glacial rebound, groundwater-surface water interaction.] A component of my research program is related to studying the hydrologic and thermal constraints inherent to aquifer thermal energy storage (ATES) applications. ATES involves the use of groundwater for supplemental heating and direct cooling of building facilities using groundwater [aquifer thermal energy storage (ATES), geothermal energy, well configurations]. My research interests also include using stable isotopes in mining / ARD problems. Isotopes include lead, hydrogen, oxygen and sulphur. I am currently collaborating with J. Mortensen (UBC Earth and Ocean Sciences) and M. Ghomshei (UBC mining) [stable isotopes, mining, acid rock drainage, groundwater].

1.3 Graduate Teaching

Semester	Type	Course	Number	Type	Enrollment
2002-3	Teaching	Groundwater Modelling	EASC707	Seminar	1
2002-1	Teaching	Field Techniques in Hydrogeology	EASC603	Lecture	3
2002-1	Teaching	Groundwater Hydrology	EASC613	Lecture	4
2002-1	Teaching	Ground Water Contamination	EASC705	Seminar	1
2001-3	Teaching	Groundwater Resource Evaluation	EASC623	Lecture	6
2001-2	Teaching	Storm Flow Geochemistry	EASC701	Seminar	1
2001-2	Teaching	Stream Geochemistry	EASC702	Seminar	1
2001-1	Teaching	Groundwater Hydrology	EASC613	Lecture	1
2000-1	Teaching	Groundwater Resource	EASC623	Lecture	4
2000-1	Teaching	Special Topics III	EASC703	Directed Studies	1
1999-3	Teaching	Groundwater Hydrol.	EASC613	Lecture	3
1999-1	Teaching	Groundwater Resource Evaluation	EASC623	Field School	1

Semester	Type	Course	Number	Type	Enrollment
1999-1	Teaching	Special Topics - Environmental Geochemistry	EASC703	Directed Studies	1
1998-2	Teaching	Special Topics-Earth Sci. III	EASC703	Directed Studies	1
1998-1	Teaching	Groundwater Resource Evaluation	EASC623	Lecture	1
1997-3	Teaching	Groundwater Hydrology	EASC613	Lecture	2
1997-3	Teaching	Applied Geophysics	EASC615	Lecture	2
1997-1	Teaching	Groundwater Hydrology	EASC613	Lecture	1

1.4 Senior Supervisory Duties of a Thesis/Dissertation/or Major Project

Name	Degree	Project/Thesis Title	Status	Began	Completed
Scibek, Jacek	M.Sc.	Impact of climate change on groundwater: Numerical simulations in watersheds in two climate regions	Active	2002-3	
Paddington, Scott	M.Sc.	Modelling the effect of material type, slope angle and groundwater flow on slope stability	Active	2001-2	
Bridger, Dave,	M.Sc.	Aquifer Thermal Energy Storage Modelling	Active	2002-1	
Liteanu, Emilia,	M.Sc.	Numerical modelling of glacial rebound and groundwater flow, Gulf Islands, B.C.	Active	2001-3	
Daniel Mackie,	M.Sc.	Structural geology of the Gulf Islands, B.C. and its relation to groundwater circulation patterns.	Active	1999-3	2002-1
Jordan-Knox, Quinn	M.Sc.	Groundwater-surface water interaction in the Cheakamus River Valley - Relevance to Salmon Habitat	Active	1999-3	2003-1
Jordan-Knox, Michael,	B.Sc. Honours	Using geostatistical methods to examine the effect of bioturbation on porosity and permeability patterns in Alberta.	Completed	2001-3	2001-3
Lepitre, Michele	M.Sc.	The Use of Stable Isotopes for the Delineation of Mining Effluent Plumes	Completed	1999-1	2001-3
Danae Voornej,	B.Sc. Honours	Stable Isotope and Hydrochemical Study of the Tailings Area, Sullivan Mine, B.C.	Completed	2000-3	2000-3
Matsuo, Gregory	B.Sc. Honours	Hydrochemical Evolution of Groundwater on Hornby Island, B.C.	Completed	2000-3	2000-3
Abbey, Daron	M.Sc.	Geophysics / Hydrogeology	Completed	1997-3	2000-1
Suchy, Martin	B.Sc. Honours	Physiographic and Geologic Controls on Groundwater Salinity Variations on Saturna Island, B.C.	Completed	1998-3	1999-1

1.5 Selected Publications

Allen, D.M., Mackie, D.C. and Wei, M. (accepted by Hydrogeology Journal, Feb 2003). Groundwater and climate change: a sensitivity analysis for the Grand Forks aquifer, southern British Columbia.

Allen, D.M. (provisionally accepted by Ground Water, Dec 2002) Determining the origin of groundwater using stable isotopes of ^{18}O , ^2H and ^{34}S .

Lepitre, M.E., Allen, D.M., Mortensen, J.K. and Gabites, J.E. (In Press). Differentiating sources of dissolved lead in mine waters using stable isotopes, Sullivan Mine, British Columbia. Water Resources Research.

Allen, D.M. and Voormeij, D.A. (In Press) Oxygen-18 and deuterium fingerprinting of tailings seepage at the Sullivan Mine. B.C. Mine Waters and the Environment.

Allen, D.M. Abbey, D.G., Mackie, D.C., Luzitano, R., and Cleary, M. (2002). Investigation of Potential Saltwater Intrusion Pathways in a Fractured Aquifer using an Integrated Geophysical, Geological and Geochemical Approach. *Journal of Environmental and Engineering Geophysics*, 7(1), p. 19-36.

Michel, F.A., Allen, D.M. and Grant, M.B. 2001. Hydrogeochemistry and Geothermal Characteristics of the White Lake Basin, British Columbia, Canada. *Geothermics*, Fall Issue, 2001.

Allen, D.M. and Suchy, M.S (2001) Geochemical Evolution of Groundwater on Saturna Island, British Columbia. *Canadian Journal of Earth Sciences*, 38, 1059-1080.

Ghomshei, M.M. and Allen, D.M. (2000). Potential Application of Oxygen-18 and Deuterium in Mining Effluent and Acid Rock Drainage (ARD) Studies. *Environmental Geology*, 39(7), p. 767-773.

Ghomshei, M.M. and Allen, D.M.(2000) Hydrochemical and Stable Isotope Assessment of Tailings Pond Leakage, Nickel Plate Mine, British Columbia. *Environmental Geology*, 39(8), p. 937-944.

Allen, D.M. and Michel, F.A. (1999) Characterizing a Faulted Aquifer by Field Testing and Numerical Simulation. *Ground Water*, 37(5), p. 718-728.

Allen, D.M. and Michel, F.A. (1998). Evaluation of multi-well test data in a faulted aquifer using linear and radial flow models. *Ground Water*, 36(6), p. 938-948.

Discussion of "Detailed Pumping Test to Characterize a Fractured Aquifer" by Gernand and Heidtman, 1996 in *Ground Water*, vol. 35, no. 4. In *Ground Water*, vol. 36, no. 2

1.6 Research/Project Funding

Contract/Grant: Discovery Grant **Period:** 2003 - 2007

Project Title: Representing Heterogeneity in Regional Fractured Sedimentary Aquifer Systems: Field Data to Models

Funding: NSERC **Type:** External **Annual:** \$19,800

Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 2002 **Period:** 2002 - 2004

Project Title: Numerical Model for Groundwater Flow and Nitrate Transport in the Abbotsford-Sumas Aquifer

Funding: Environment Canada **Type:** External **Annual:** \$10,000 **Total:** \$20,000

Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 2002 **Period:** 2002 - 2003

Project Title: Hydrogeologic Mapping and Characterization of the Grand Forks Aquifer.

Funding: BC Ministry of Water, Land and Air Protection **Type:** External **Total:** \$25,000

Involvement: Principal Investigator

Contract/Grant: Research Grant **Period:** 2001 - 2004

Project Title: Linkages between crustal structure and bedrock aquifers in the Cascadia forearc, southwest, B.C.

Funding: NRCan - GSC **Type:** External **Total:** 188,000

Involvement: Joint Investigator **Collaboration:** Murray Journeay, Geological Survey of Canada; Bob Turner, GSC; Sonia Talwar, GSC; Eric de Kemp, GSC.

Contract/Grant: Research Grant **Awarded:** 2002 **Period:** 2002 - 2003

Project Title: Climate Change and Groundwater: A modelling approach for identifying impacts and resources sustainability in the central interior of British Columbia

Funding: NRCan - Climate Change Action Fund **Type:** External **Total:** \$37,000

Involvement: Principal Investigator **Collaboration:** M. Wei - BC Ministry of Water, Land and Air Protection P. Whitfield - Environment Canada

Contract/Grant: Research Grant **Awarded:** 2002 **Period:** 2002 - 2003

Project Title: Determining the Hydraulic Properties of Fractured Bedrock Aquifers on the Gulf Islands

Funding: BC Ministry of Water, Land and Air Protection **Type:** External **Total:** 6,000

Involvement: Principal Investigator

Contract/Grant: Operating Grant **Period:** 2000 - 2003
Project Title: Fluid Flow and Solute Transport in Shallow Subsurface Fault Zones
Funding: NSERC **Type:** External **Annual:** \$17,000
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 2000 **Period:** 2000 - 2002
Project Title: Hydrogeological Study of Hornby Island, B.C.
Funding: Islands Trust **Type:** External **Total:** \$17,529
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 2000 **Period:** 2000 - 2002
Project Title: Cheakamus Valley Hydrogeological Study
Funding: BC Hydro **Type:** External **Total:** \$5000
Involvement: Principal Investigator

Contract/Grant: Contract **Awarded:** 2001 **Period:** 2001 - 2001
Project Title: Stormflow and Baseflow Water Chemistry Sampling Program.
Funding: Burnaby Mountain Development Corporation **Type:** Internal **Total:** 5800.00
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 2000 **Period:** 2000 - 2001
Project Title: Stable Isotope Geochemistry of Tailings Pond Seepage, Sullivan Mine, B.C.
Funding: Cominco Ltd. **Type:** External **Total:** \$7000
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 2000 **Period:** 2000 - 2001
Project Title: Climate Change and Groundwater: A Modelling Approach for Identifying Impacts and Resources Sustainability in the Grand Forks Aquifer, B.C.
Funding: British Columbia Ministry of Environment, Lands and Parks **Type:** External **Total:** \$5000
Involvement: Principal Investigator

Contract/Grant: Infrastructure/equipment grants **Awarded:** 2000 **Period:** 2000 - 2001
Project Title: Pacific Centre for Isotopic and Geochemical Research
Funding: Canadian Foundation for Innovation (\$1,053,000); UBC Stuart Blussion Research Fund (matching to CFI grant) (\$527,700); B.C. Knowledge Fund (matching to CFI grant) (\$1053,000)
Involvement: Joint Investigator **Collaboration:** co-investigator with 13 others as a research consortium which will share several new analytical instruments, plus preparation laboratories; all to be housed at UBC
Institution of Co-Investigator(s): UBC, SFU, UVic, U of Alberta

Contract/Grant: Chemical analysis costs **Awarded:** 2000 **Period:** 2000 - 2000
Project Title: Chemical sampling of groundwaters and surface waters in the Cheakamus River Valley
Funding: BC Ministry of Environment, Lands and Parks **Type:** External **Total:** \$12,000
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1999 **Period:** 1999 - 2000
Project Title: Stable isotope investigation of Saturna Island groundwaters
Funding: Saturna Island Local Trust **Type:** External **Total:** \$2,000
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1999 **Period:** 1999 - 2000
Project Title: Numerical Modelling of the Grand Forks Aquifer, Southern British Columbia
Funding: BC Ministry of Environment, Lands and Parks, Groundwater Section **Type:** External **Annual:** \$5000
Involvement: Principal Investigator **Collaboration:** Design a numerical model of the Grand Forks Aquifer to assess well capture zones.

Contract/Grant: Research Grant **Awarded:** 1998 **Period:** 1998 - 2000

Project Title: Hydrogeology of Saturna Island, B.C.

Funding: Saturna Island Trust Fund **Total:** \$7,500

Involvement: Principal Investigator **Collaboration:** Monetary support (\$7,500) for travel and chemical analyses; in addition, "in kind" contributions include maps and accommodation

Contract/Grant: Research Grant **Awarded:** 1998 **Period:** 1998 - 1999

Project Title: Assessment of Methodologies for Analyzing Pumping Test Data for Wells and Aquifers in British Columbia

Funding: British Columbia Ministry of Environment, Lands and Parks **Total:** \$5000

Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1998 **Period:** 1998 - 1998

Project Title: A Comprehensive Evaluation of ATEs Software Packages for use in Differing Geologic Systems

Funding: Environment Canada, Dartmouth, N.S. **Total:** \$4,200

Involvement: Principal Investigator

Contract/Grant: Software Grant **Awarded:** 1998 **Period:** 1998 - 1998

Project Title: 3-D Heat and Solute Transport Modelling Software, HST3D by IF Technologies, The Netherlands

Funding: Environment Canada **Type:** External **Total:** \$3000.00

Involvement: Principal Investigator

Contract/Grant: Equipment Grant **Awarded:** 1998 **Period:** 1998 - 1998

Project Title: Submersible datalogger: Pressure Transducer and Thermistor. Troll 4000, In Situ Loggers.

Funding: Turner Groundwater Consultants **Type:** External **Total:** \$4000

Contract/Grant: Research Grant **Awarded:** 1997 **Period:** 1997 - 1998

Project Title: Groundwater Resources of the Gulf Islands

Funding: Simon Fraser University - President's Research Grant **Total:** \$15,700.00

Involvement: Principal Investigator

2. Dr Andrew Calvert, Associate Professor (Geophysics)

2.1 Educational Background

1985 Ph.D. Geophysics, Bullard Laboratories, Cambridge University, U.K.

Seismic studies of the Atlantic fracture zones: Charlie-Gibbs and Tydeman

1981 B.A. Mathematics (1st class), St. Edmund Hall, Oxford University, U.K.

2.2 Current Research Interests

Geophysics theory and applications, particularly in relation to global-scale tectonics

2.3 Graduate Teaching

Semester	Type	Course	Number	Session	Type	Hours	Enrollment
2002-1	Teaching	Seismic Applications Prog.	EASC 706	G01.00	Seminar		1
2001-3	Teaching	Exploration Seismology	EASC 607	G01.00	Lecture		1
2001-3	Teaching	Geophysical Time Series Analysis	EASC 703	G01.00	Seminar		1

2.4 Senior Supervisory Duties of a Thesis/Dissertation/or Major Project

Name	Degree	Project/Thesis Title	Status	Began	Completed
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Name	Degree	Project/Thesis Title	Status	Began	Completed
Zeng, Fafu	M.Sc.	Mapping near-surface lithologies of the Red Lake greenstone belt using 3-D first arrival tomography	Active	2001-3	
Blay, Christopher	M.Sc.	Estimation of the elastic properties of Cascadia margin sediments using seismic reflection data.	Active	2000-1	

2.5 Selected Publications

Calvert, A.J., Fisher, M.A., and SHIPS working group, 2001, Imaging the Seattle Fault Zone with high-resolution seismic tomography, Geophys. Res. Lett., 28, 2337-2340.

Adam, E., Perron, G., Milkereit, B., Wu, J., Calvert, A.J., Salisbury, M., Verpaelt, P., and Dion, D.-J., 2000, A review of high-resolution seismic profiling across the Sudbury, Selbaie, Noranda and Matagami mining camps, Can. J. Earth Sci., 37, 503-516.

Martignole, J., Calvert, A.J., Friedman, R. and Reynolds, P., 2000, Crustal evolution along a seismic section across the Grenville Province (western Québec), Can. J. Earth Sci., 37, 291-306.

Fullagar, P.K., Livelybrooks, D.W., Zhang, P., Calvert, A.J., and Wu, Y., 2000, Radio tomography and borehole radar delineation of the McConnell nickel sulfide deposit, Sudbury, Ontario, Geophysics, 65, 1920-1930.

Calvert, A.J. and Li, Y., 1999, Seismic reflection imaging over a massive sulfide deposit at the Matagami mining camp, Québec, Geophysics, 64, 24-32.

Calvert, A.J. and Ludden, J.N., 1999, Archean continental assembly in the southeastern Superior Province of Canada, Tectonics, 18, 412-429.

Bellefleur, G., Calvert, A.J. and Chouteau, M., 1998, Crustal geometry of the Abitibi Subprovince, in light of three-dimensional seismic reflector orientations, Can. J. Earth Sci., 35, 569-582.

Perron, G. and Calvert, A.J., 1998, Shallow, high-resolution seismic imaging at the Ansil mining camp in the Abitibi greenstone belt, Geophysics, 63, 379-391.

Bellefleur, G., Calvert, A.J. and Chouteau, M.C., 1997, A link between deformation history and the orientation of reflective structures in the 2.68-2.83 Ga Opatoca Belt of the Canadian Superior Province, J. Geophys. Res., 102, 15243-15257.

Calvert, A.J., 1997, Backscattered coherent noise and seismic reflection imaging of the oceanic crust: An example from the rift valley of the Mid-Atlantic Ridge at 23°N, J. Geophys. Res., 102, 5119-5134.

Choukroune, P., Ludden, J.N., Chardon, D., Calvert, A.J. and Bouhallier, H., 1997, Archaean crustal growth and tectonic processes: a comparison of the Superior Province, Canada and the Dharwar craton, India. *In Orogeny Through Time*, edited by J.-P. Burg and M. Ford, Geol. Soc. Spec. Pub. No. 121, 63-98.

Calvert, A.J., 1998, On: "Suppression of sea-floor-scattered energy using a dip-moveout approach - Application to the mid-ocean ridge environment" by G.M. Kent, I.I. Kim, A.J. Harding, R.S. Detrick, and J.A. Orcutt (Geophysics, 61, 821-834, May-June (1996)), Geophysics, 63, 316-319.

Calvert, A.J. and Livelybrooks, D., 1997, Borehole-radar reflection imaging at the McConnell nickel deposit, Sudbury. *In Proceedings of Exploration 97: 4th Decennial International Conference on Mineral Exploration*, edited by A.G. Gubins, 701-704, Prospectors and Developers Association of Canada, Toronto.

Li, Y. and Calvert, A.J., 1997, Seismic reflection imaging of a shallow, fault-controlled VMS deposit in the Matagami mining camp, Québec. *In Proceedings of Exploration 97: 4th Decennial International Conference on Mineral Exploration*, edited by A.G. Gubins, 467-472, Prospectors and Developers Association of Canada, Toronto.

2.6 Research/Project Funding

Contract/Grant: Research Grant **Awarded:** 2002 **Period:** 2002 - 2006
Project Title: CASSIS: The Cascadia collaborative seismic experiment
Funding: NSERC-Collaborative Research Opportunities **Type:** External **Annual:** \$249,950 **Total:** \$999,800
Involvement: Principal Investigator **Collaboration:** Japan-Canada seismic survey off west coast of Vancouver Island, G. Spence (co-PI), R. Hyndman, K. Wang, S. Dosso, M. Bostock, K. Loudon
Institution of Co-Investigator(s): Japan Marine Science and Technology Centre, Geological Survey of Canada, UVic, UBC, Dalhousie

Contract/Grant: Operating Grant **Awarded:** 1999 **Period:** 1999 - 2003
Project Title: Lithology prediction from seismic reflection data
Funding: NSERC **Type:** External **Annual:** \$35,700 **Total:** \$142,800
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 2001 **Period:** 2002 - 2002
Project Title: Tomographic imaging of shallow crustal faults in the Puget Lowland and Strait of Juan de Fuca using SHIPS reflection data

Funding: USGS National Earthquake Hazards Reduction Program **Type:** External **Annual:** \$40,084 **Total:** \$40,084
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 2001 **Period:** 2001 - 2001
Project Title: LITHOPROBE-GLOBE Claritas software
Funding: NSERC-LITHOPROBE **Type:** External **Annual:** \$13,000 **Total:** \$13,000
Involvement: Principal Investigator

Contract/Grant: Industry Software Donation **Awarded:** 2001 **Period:** 2001 - 2001
Project Title: GeoDepth seismic imaging software
Funding: Paradigm Geophysical Corporation **Type:** External **Annual:** \$90,000 **Total:** \$90,000
Involvement: Principal Investigator

Contract/Grant: Equipment Grant **Awarded:** 1999 **Period:** 1999 - 2000
Project Title: A computer network for the estimation of lithology from seismic reflection data
Funding: NSERC **Type:** External **Annual:** \$41,139 **Total:** \$41,139
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1998 **Period:** 1999 - 2000
Project Title: Near-surface characterization using 3-D seismic methods
Funding: President's Research Grant **Type:** Internal **Annual:** \$11,800 **Total:** \$11,800
Involvement: Principal Investigator

Contract/Grant: Industry Software Donation **Awarded:** 1999 **Period:** 1999 - 1999
Project Title: SeisX seismic interpretation software
Funding: Paradigm Geophysical Corporation **Type:** External **Annual:** \$59,000 **Total:** \$59,000
Involvement: Principal Investigator

Contract/Grant: Fellowship **Awarded:** 1998 **Period:** 1998 - 1999
Project Title: Research Fellowship for New Faculty
Funding: Simon Fraser University **Type:** Internal **Annual:** \$5,000 **Total:** \$5,000
Involvement: Principal Investigator

Contract/Grant: Industry Software Donation **Awarded:** 1998 **Period:** 1998 - 1999
Project Title: Kingdom Suite seismic interpretation software
Funding: Seismic Micro-Technology **Type:** External **Annual:** \$43,000 **Total:** \$43,000
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1996 **Period:** 1996 - 1997
Project Title: Reprocessing of Abitibi-Grenville Phase II reflection data
Funding: NSERC-Lithoprobe **Type:** External **Annual:** \$43,000 **Total:** \$43,000

Involvement: Joint Investigator **Collaboration:** C. Hurich, A. Indares
Institution of Co-Investigator(s): Memorial University

Contract/Grant: Operating Grant **Awarded:** 1994 **Period:** 1994 - 1997
Project Title: 3-D seismic reflection surveying for mineral exploration
Funding: NSERC **Type:** External **Annual:** \$20,000 **Total:** \$60,000
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1994 **Period:** 1994 - 1997
Project Title: New geophysical approaches to mineral exploration
Funding: FCAR Team **Type:** External **Annual:** \$100,000 **Total:** \$300,000
Involvement: Joint Investigator **Collaboration:** M. Chouteau, M. Mareschal, P. Fullagar, D. Marcotte
Institution of Co-Investigator(s): Ecole Polytechnique de Montréal

3. Dr John Clague, Professor & Shrum Chair in Science (Quaternary Geology & Environmental Geology)

3.1 Educational Background

1973 Ph.D. Geology, University of British Columbia, Canada
 1969 M.A. Geology, University of California, United States
 1967 A.B. magna cum laude Occidental College, United States

3.2 Current Research Interests

Landslides in the Canadian Cordillera [Geology, geomorphology, landslides, natural hazards]; Natural dam failure [Geology, geomorphology, natural hazards]; Late Holocene climatic and environmental change [Geology, geomorphology, stratigraphy, sedimentology, paleoecology]; Earthquake and tsunami history of southwestern British Columbia [Geology, geomorphology, stratigraphy, natural hazards]; Quaternary stratigraphy and history of British Columbia [Geology, geomorphology, stratigraphy, sedimentology]

3.3 Graduate Teaching

Semester	Type	Course	Number	Session	Type	Hours	Enrollment
2003-1	Teaching	Directed Readings	EASC711		Seminar		1
2003-1	Teaching	Quaternary Geology	EASC617	G01.00	Lecture		3
2002-3	Teaching	Special Topics	EASC 708	G01.00	Seminar		2
2002-1	Teaching	Quaternary Paleo- Environmental Res.	EASC703	G01.00	Seminar		10
2001-1	Teaching	Quaternary Geology	EASC617	G01.00	Lecture	0.08	1
2000-1	Teaching	Quaternary Geology	EASC617		Lecture	0.67	5
1999-3	Teaching	St- Quaternary of Bc	EASC703		Seminar	3.33	4

3.4 Senior Supervisory Duties of a Thesis/Dissertation/or Major Project

Name	Degree	Project/Thesis Title	Status	Began	Completed
Koch, Johannes,	Ph.D.	Late Holocene environments, Garibaldi Park, British Columbia	Active	2002-1	2006-1
Riedel, Jon	Ph.D.	Quaternary geology and climatic history of the upper Skagit River watershed, Washington state	Active	2001-1	2005-1
Reyes, Alberto	M.Sc.	Holocene history of Lillooet and Bishop glaciers, British Columbia	Active	2001-3	2003-3
Sabeau, Jennifer	M.Sc.	Late Holocene relative sea-level change, Willapa Bay, southwestern Washington state	Active	2001-3	2003-3

Name	Degree	Project/Thesis Title	Status	Began	Completed
Walker, Lauren	M.Sc.	Late Pleistocene and early Holocene glaciation in the Coast Mountains, British Columbia	Active	2001-3	2003-3
Tribe, Selina	Ph.D.	Preglacial drainage and Tertiary erosion history of the British Columbia Interior Plateau	Active	1999-3	2003-3
Gutsell, Jeffrey	M.Sc.	Geology of Zeballos River delta, British Columbia	Active	1999-3	2002-1
Kershaw, Jane	M.Sc.	Nostetuko River outburst floods	Active	1999-3	2002-1

3.5 Selected Publications

Friele, P.A. and Clague, J.J. 2002. Readvance of glaciers in the British Columbia Coast Mountains at the end of the last glaciation. *Quaternary International*, v. 87, p. 45-58.

Clague and James, T.S. 2002. History and isotatic effects of the last ice sheet in southern British Columbia. *Quaternary Science Reviews*, v. 21, p. 71-87.

Blais-Stevens, A. and Clague, J.J. 2001. Paleoseismic signature in late Holocene sediment cores from Saanich Inlet, British Columbia. *Marine Geology*, v. 175, p. 131-148.

Evans, S.G., Hungr, O., and Clague, J.J. 2001. Dynamics of the 1984 rock avalanche and associated debris flow on Mount Cayley, British Columbia, Canada; implications for landslide hazard assessment on dissected volcanoes. *Engineering Geology*, v. 61, p. 29-51.

Huntley, D.H., Bobrowsky, P.T., and Clague, J.J. 2001. Ocean Drilling Program Leg 159S: Surficial geology, stratigraphy and geomorphology of the Saanich Inlet area, southeastern Vancouver Island, British Columbia. *Marine Geology*, v. 174, p. 27-41.

Clague, J.J., Turner, R.J.W., Bates, J., Haidl, F., Morgan, A.V., and Vodden, C. 2001. Earth Science Education 4. Geoliteracy Canada, a national geoscience education initiative. *Geoscience Canada*, v. 28, p. 143-149.

Clague, J.J. 2000. Recognizing order in chaotic sequences of Quaternary sediments in the Canadian Cordillera. *Quaternary International*, v. 68-71, p. 29-38.

Clague, J.J. and Slaymaker, O. 2000. Canadian geomorphology 2000: Introduction. *Geomorphology*, v. 32, p. 203-221.

Clague, J.J. and Turner, R.J. 2000. Climate change in southwestern British Columbia: Extending the boundaries of earth science. *Geoscience Canada*, v. 27, p. 111-120.

Clague, J.J., Bobrowsky, P.T., and Hutchinson, I. 2000. A review of geological records of large tsunamis at Vancouver Island, British Columbia. *Quaternary Science Reviews*, v. 19, p. 849-863.

Hutchinson, I., Guilbault, J-P., Clague, J.J., and Bobrowsky, P.T. 2000. Tsunamis and tectonic deformation at the northern Cascadia margin: a 3000-year record from Deserted Lake, Vancouver Island, British Columbia. *The Holocene*, v. 10, p. 429-439.

James, T.S., Clague, J.J., Wang, K., and Hutchinson, I. 2000. Postglacial rebound at the northern Cascadia subduction zone. *Quaternary Science Reviews*, v. 19, p. 1527-1541.

Clague, J.J. and Evans, S.G. 2000. A review of catastrophic drainage of moraine-dammed lakes in British Columbia. *Quaternary Science Reviews*, v. 19, p. 1763-1783.

Patterson, R.T., Hutchinson, I., Guilbault, J.-P., and Clague, J.J. 2000. A comparison of the vertical zonation of diatom, foraminifera, and macrophyte assemblages in a coastal marsh: Implications for greater paleo-sea level resolution. *Micropaleontology*, v. 46, p. 229-244.

Clague, J.J. and Turner, R.J. 2000. Climate change in southwestern British Columbia: Extending the boundaries of earth science. *Geoscience Canada*, v. 27, p. 111-120.

Patterson, R.T., Hutchinson, I., Guilbault, J.-P., and Clague, J.J. 2000. A comparison of the vertical zonation of diatom, foraminifera, and macrophyte assemblages in a coastal marsh: Implications for greater paleo-sea level resolution. *Micropaleontology*, v. 46, p. 229-244.

Clague, J.J. and Bobrowsky, P.T. 1999. The geological signature of great earthquakes off Canada's west coast. *Geoscience Canada*, v. 26, p. 1-15.

Clague, J.J., Hutchinson, I., Mathewes, R.W., and Patterson, R.T. 1999. Evidence for late Holocene tsunamis at Catala Lake, British Columbia. *Journal of Coastal Research*, v. 15, p. 45-60.

Patterson, R.T., Guilbault, J.-P., and Clague, J.J. 1999. Taphonomy of tidal marsh foraminifera: implications of surface sample thickness for high-resolution sea-level studies. *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 149, p. 199-211.

Benson, B.E., Clague, J.J., and Grimm, K.A. 1999. Relative sea-level change inferred from intertidal sediments beneath marshes on Vancouver Island, British Columbia. *Quaternary International*, v. 60, p. 49-54.

Clague, J.J., Mathewes, R.W., Guilbault, J.-P., Hutchinson, I., and Ricketts, B.D. 1998. 'Pre-Younger Dryas resurgence of the southwestern margin of the Cordilleran Ice Sheet, British Columbia, Canada': Reply to comments. *Boreas*, v. 27, p. 229-230.

Clague, J.J., Turner, R.J.W., and Groulx, B.J. 1997. Reinventing the geological map: making geoscience more accessible to Canadians. *Geoscience Canada*, v. 24, p. 161-172.

Clague, J.J. 1997. Evidence for large earthquakes at the Cascadia subduction zone. *Reviews of Geophysics*, v. 35, p. 439-460.

Clague, J.J., Mathewes, R.W., Guilbault, J.-P., Hutchinson, I., and Ricketts, B.D. 1997. Pre-Younger Dryas resurgence of the southwestern margin of the Cordilleran ice sheet, British Columbia, Canada. *Boreas*, v. 26, p. 261-278.

Clague, J.J., Naesgaard, E., and Nelson, A.R. 1997. Age and significance of earthquake-induced liquefaction near Vancouver, British Columbia, Canada. *Canadian Geotechnical Journal*, v. 34, p. 53-62.

Benson, B.E., Grimm, K.A., and Clague, J.J. 1997. Tsunami deposits beneath tidal marshes on northwestern Vancouver Island, British Columbia. *Quaternary Research*, v. 48, p. 192-204.

Blais-Stevens, A., Clague, J.J., Bobrowsky, P.T., and Patterson, R.T. 1997. Late Holocene sedimentation in Saanich Inlet, British Columbia, and its paleoseismic implications. *Canadian Journal of Earth Sciences*, v. 34, p. 1345-1357.

Gilbert, R., Desloges, J.R., and Clague, J.J. 1997. The glacial-lacustrine sedimentary environment of Bowser Lake in the northern Coast Mountains of British Columbia, Canada. *Journal of Palaeolimnology*, v. 17, p. 331-346.

Hallett, D.J., Hills, L.V., and Clague, J.J. 1997. New accelerator mass spectrometry radiocarbon ages for the Mazama tephra layer from Kootenay National Park, British Columbia. *Canadian Journal of Earth Sciences*, v. 34, p. 1202-1209.

Hutchinson, I., Clague, J.J., and Mathewes, R.W. 1997. Reconstructing the tsunami record of an emerging coast: a case study of Kanim Lake, Vancouver Island, British Columbia, Canada. *Journal of Coastal Research*, v. 13, p. 545-553.

Thompson, S.C., Clague, J.J., and Evans, S.G. 1997. Holocene activity of the Mt. Currie scarp, Coast Mountains, British Columbia, and implications for its origin. *Environmental and Engineering Geoscience*, v. 3, p. 329-348.

3.6 Research/Project Funding

Contract/Grant: Strategic Grant **Awarded:** 2001 **Period:** 2001 - 2005

Project Title: Sweden-Canada climate change exchange project (SWECAN)

Funding: STINT (Swedish Foundation for International Cooperation in Research and Higher Education) **Type:** External

Annual: SEK 500,000 **Total:** SEK 2,000,000
Involvement: Principal Investigator **Collaboration:** B. Wohlfarth
Institution of Co-Investigator(s): Lund University
Contract/Grant: Research Grant **Awarded:** 2001 **Period:** 2001 - 2004
Project Title: Late Holocene environmental and climate change, southern Coast Mountains
Funding: NSERC **Type:** External **Annual:** \$30,560 **Total:** \$91,180
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1998 **Period:** 1998 - 2003
Project Title: Shrum Chair Research Grant
Funding: Simon Fraser University **Type:** Internal **Annual:** \$55,000 **Total:** \$275,000
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 2001 **Period:** 2001 - 2002
Project Title: Catastrophic landslides and related processes in the southeastern Cordillera; analysis of impact on lifelines and communities
Funding: Emergency Preparedness Canada **Type:** External **Annual:** \$35,000 **Total:** \$35,000
Involvement: Joint Investigator **Collaboration:** S.G. Evans, R. Couture, O. Hungr
Institution of Co-Investigator(s): Geological Survey of Canada, University of British Columbia
Contract/Grant: Research Grant **Awarded:** 2001 **Period:** 2001 - 2002
Project Title: Distribution and mechanics of long run-out landslides in the Fort Nelson Forest District and implications for forest management
Funding: Forest Renewal BC **Type:** External **Annual:** \$74,500 **Total:** \$74,500
Involvement: Joint Investigator **Collaboration:** M. Geertsema, D.M. Cruden, O. Hungr
Institution of Co-Investigator(s): B.C. Ministry of Forests, University of Alberta, University of British Columbia

Contract/Grant: Contribution **Awarded:** 1999 **Period:** 1999 - 2000
Project Title: Climate change poster
Funding: Environment Canada, Climate Change Action Fund **Type:** External **Annual:** \$55,700 **Total:** \$55,700
Involvement: Principal Investigator **Collaboration:** R.J.W. Turner, E. Taylor, B. Taylor, N. Grenier
Institution of Co-Investigator(s): Geological Survey of Canada, Environment Canada

Contract/Grant: Operating Grant **Awarded:** 1998 **Period:** 1998 - 2000
Project Title: Natural dam failure in the Canadian Cordillera
Funding: NSERC **Type:** External **Annual:** \$21,631 **Total:** \$43,262
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1998 **Period:** 1998 - 1999
Project Title: Paleotsunami investigations, northern Cascadia subduction zone
Funding: U.S. Geological Survey National Earthquake Hazards Reduction Program **Type:** External **Annual:** \$64,000 US **Total:** \$64,000 US
Involvement: Joint Investigator **Collaboration:** P.T. Bobrowsky, I. Hutchinson, R.W. Mathewes, K. Grimm
Institution of Co-Investigator(s): B.C. Geological Survey, Simon Fraser University, University of British Columbia

Contract/Grant: Operating Grant **Awarded:** 1998 **Period:** 1998 - 1999
Project Title: Precise relative sea level reconstructions from isolation basins: tectonic and paleoenvironmental reconstructions
Funding: NSERC **Type:** External **Annual:** \$15,000 **Total:** \$15,000
Involvement: Joint Investigator **Collaboration:** I. Hutchinson, T. James
Institution of Co-Investigator(s): Simon Fraser University, Geological Survey of Canada

Contract/Grant: Research Grant **Awarded:** 1997 **Period:** 1997 - 1998
Project Title: Paleotsunami investigations, northern Cascadia subduction zone
Funding: U.S. Geological Survey National Earthquake Hazards Reduction Program **Type:** External **Annual:** \$50,000 US **Total:** \$50,000 US
Involvement: Joint Investigator **Collaboration:** P.T. Bobrowsky, I. Hutchinson, R.W. Mathewes, K. Grimm
Institution of Co-Investigator(s): B.C. Geological Survey, Simon Fraser University, University of British Columbia

Contract/Grant: A-Base Research Funds **Awarded:** 1989 **Period:** 1989 - 1998
Project Title: Quaternary crustal deformation, western British Columbia and southwest Yukon
Funding: Geological Survey of Canada **Type:** External **Annual:** ca. \$25,000 **Total:** ca. \$250,000
Involvement: Principal Investigator

4. Dr Laurent Godin, Assistant Professor (Structural Geology)

4.1 Educational Background

1999 Ph.D. Earth Sciences, Carleton University, Canada
Tectonic evolution of the Tethyan sedimentary sequence in the Annapurna area, central Nepal Himalaya
1993 M.Sc. Earth Sciences, Université du Québec à Montréal, Canada
Structural analysis of the folded Abloviak shear zone, Paleoproterozoic Torngat Orogen
1991 B.Sc. Géologie, Université du Québec à Montréal, Canada

4.2 Current Research Interests

Tectonic evolution of the sub-Himalayan foreland basin in the Hazara-Kashmir syntaxis, northern Pakistan
[Age, Provenance, structural evolution of the Eocene to Oligocene Balakot Formation, transition between marine and continental sedimentation during the incipient stages of the Himalayan orogen]
Structural evolution of Himalayan crystalline domes and their role during continental orogenesis
[Himalaya, structural geology, Continental tectonics, exhumation of metamorphic rocks]
Magmatic and solid-state flow microstructures preserved in an Archean granulite terrain, northeastern Superior Province, northern Quebec. [Microtectonics, Quartz petrofabrics, magmatic and solid-state fabrics]
Neotectonic-seismic risk assessment of the Rouge River valley near the Pickering nuclear power plant, Toronto, Ontario, Canada [Seismic risk assessment, neotectonics, structural geology, glacio-tectonics]

4.3 Graduate Teaching

Semester	Type	Course	Number	Session	Type	Hours	Enrollment
2002-3	Teaching	Directed Readings	EASC 711	G01.00	Seminar		2
2002-1	Teaching	Deform.Mechanisms/ Continental Tectonics	EASC 604	G01.00	Lecture		3
2002-1	Teaching	Deformation mechanisms and continental tectonics	EASC604	G01.00	Lecture	3.00	3

4.4 Senior Supervisory Duties of a Thesis/Dissertation/or Major Project

Name	Degree	Project/Thesis Title	Status	Began	Completed
Roenitz, Oliver,	B.Sc.	Detailed structural assembly of the Cache Creek Terrane - Mt. O'Keefe area, northern BC.	Active	2002-3	
Gleeson, Tom,	M.Sc.	Structural geometry and kinematics of the Chako dome, central Nepal Himalaya: An incipient core complex?	Active	2001-3	
Nadeau, Pierre,	M.Sc.	Microstructures preserved in an Archean granulite terrain: Transition from magmatic to solid-state flow, northeastern Superior Province, northern Quebec.	Active	2001-3	

4.5 Selected Publications

Godin, L., Brown, R. L., Dreimanis, A., Atkinson, G. M., and Armstrong, D. 2003. Analysis and reinterpretation of deformation features in the Rouge River valley, Scarborough, Ontario – Reply: Canadian Journal of Earth Sciences, v. 40, *in press*.

Godin, L. 2003. Structural evolution of the Tethyan sedimentary sequence in the Annapurna area, central Nepal Himalaya: *Journal of Asian Earth Sciences*. *in press*.

Searle, M. P. and Godin, L. 2003. The South Tibetan detachment system and the Manaslu leucogranite: A structural reinterpretation and restoration of the Annapurna – Manaslu Himalaya, Nepal: *Journal of Geology*. *in press*.

Godin, L., Brown, R. L., Dreimanis, A., Atkinson, G. M., and Armstrong, D. 2002. Analysis and reinterpretation of deformation features in the Rouge River valley, Scarborough, Ontario: *Canadian Journal of Earth Sciences*, v. 39, p. 1373-1391.

Najman, Y., Pringle, M., Godin, L., and Oliver, G. 2002. A reinterpretation of the Balakot Formation: Implications for tectonics of the NW Himalaya, Pakistan: *Tectonics*, v. 21, p. 9.1-9.18. DOI 10.1029/2001TC001337.

Godin, L., Parrish, R., Brown, R. L., and Hodges, K. V., 2001. Crustal thickening leading to exhumation of the Himalayan metamorphic core of central Nepal: Insight from U-Pb geochronology and ⁴⁰Ar/³⁹Ar thermochronology: *Tectonics*, v. 20, p. 729-747.

Najman, Y., Pringle, M., Godin, L., and Oliver, G. 2001. Dating of the oldest continental sediments from the Himalayan orogeny. *Nature*, v. 410, p. 194-197.

Godin, L., 2000. Book review for "Tectonics of the Nanga Parbat Syntaxis and the Western Himalaya. Edited by M. A. Khan, P. J. Treloar, M. P. Searle, M. P., and M. Q. Jan, 2000: Special Publication 170. London: Geological Society. 485 p.". *Progress in Physical Geography*, v. 24, p. 620-621.

Godin, L., Brown, R. L., Hanmer, S., and Parrish, R., 1999. Back folds in the core of the Himalayan orogen: An alternative interpretation: *Geology*, v. 27, p. 151-154.

Godin, L., Brown, R. L., and Hanmer, S., 1999. High strain zone in the hanging wall of the Annapurna detachment, central Nepal Himalaya In *Himalaya and Tibet: Mountain roots to mountain tops*. Edited by A. Macfarlane, R. B. Sorkhabi, and J. Quade. Geological Society of America Special Paper 328, p. 199-210.

4.6 Research/Project Funding

Contract/Grant: Research Grant **Awarded:** 2001 **Period:** 2001 - 2005

Project Title: Structural evolution of Himalayan domes and their role during continental orogenesis

Funding: NSERC **Type:** External **Annual:** \$35,000 **Total:** \$140,000

Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 2002 **Period:** 2002

Project Title: Detailed structural investigation of the Upper Goldbottom creek, Cache Creek terrane, northern BC

Funding: British Columbia Geological Survey **Type:** External **Annual:** \$9,334 **Total:** \$9,334

Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 2001 **Period:** 2001 - 2001

Project Title: Nar 2001 Research Expedition

Funding: President's Research Grants **Type:** Internal **Annual:** \$8,900 **Total:** \$8,900

Involvement: Principal Investigator

Contract/Grant: Start-up Grant **Awarded:** 2000 **Period:** 2000 - 2001

Project Title: Laboratory and office equipment purchases

Funding: Simon Fraser University **Type:** Internal **Annual:** \$60,000 **Total:** \$60,000

Involvement: Principal Investigator

Contract/Grant: Endowed Research Grant **Awarded:** 2000 **Period:** 2000 - 2001

Project Title: Attendance to the 16th Himalaya-Karakoram-Tibet workshop, and user fee for large-format printer

Funding: Simon Fraser University **Type:** Internal **Annual:** \$5,000 **Total:** \$5,000

Involvement: Principal Investigator

5 Dr Edward J. Hickin, Professor (Fluvial Geomorphology & Sedimentology)

5.1 Educational Background

1971 PhD Geomorphology, University of Sydney, Sydney, Australia

1966 BA (first-class honours) Geomorphology, University of Sydney, Sydney, Australia

5.2 Current Research Interests

Morphodynamics of river channels and sedimentology of fluvial deposits [river geomorphology, fluvial sedimentology]

5.3 Graduate Teaching

Semester	Type	Course	Number	Session	Type	Hours	Enrollment
2000-3	Teaching	Fluvial Systems	EASC616		Directed Studies	1.50	1
2000-3	Teaching	ST-Fluid Mechanics	EASC701		Directed Studies	0.50	1
2000-1	Teaching	Fluvial Systems	EASC616		Directed Studies	1.50	2
2000-1	Teaching	ST-Fluid Mechanics	EASC701		Directed Studies	0.50	2
2000-1	Teaching	Fluvial Geomorpholog	GEOG726		Laboratory	2.35	3
2000-1	Teaching	Fluvial Geomorpholog	GEOG726		Lecture	2.35	3
1999-1	Teaching	Fluvial Systems	EASC616		Lecture and Laboratory	1.50	1
1999-1	Teaching	Fluvial Geomorpholog	GEOG726		Directed Studies	2.00	1

5.4 Senior Supervisory Duties of a Thesis/Dissertation/or Major Project

Name	Degree	Project/Thesis Title	Status	Began	Completed
Ray, Derek	M.Sc.	Rivers on alluvial fans, Queen Charlotte Islands	Active	1999-3	
Simpson, Christopher	Ph.D.	River Planform Domains in Sandbed Rivers	Active	1999-3	
Tabata, Kevin	M.Sc.	Secondary Channels in Gravel-Bed Rivers	Completed	1999-3	2002-2
Wooldridge, Colin	M.Sc.	Internal Architecture of Modern Channel Bars in Gravel-Bed Rivers using GPR Imaging	Completed	1999-3	2002-2
Pelpola, Channa	M.Sc.	Sediment yield from Fitzsimmons Creek, Whistler, British Columbia	Completed	1998-3	2001-1
Ekes, Csaba	Ph.D.	Radar facies and sedimentology of alluvial fans	Completed	1994-1	2000-1
Paige, Alan	M.Sc.	Seasonal scour/fill regime, Squamish River, B.C.	Completed	1994-3	1999-1
Prent, Mariette	M.Sc.	Seasonal bedform regime, Lillooett River, B.C.	Completed	1994-3	1998-2

5.5 Selected Publications

Wooldridge, C.L. & Hickin, E.J. 2002. Step-pool and cascade morphology, Mosquito Creek, British Columbia: a test of four analytical techniques. *Canadian Journal of Earth Sciences*, 39, 493--503

Prent, M.T.H. & Hickin, E.J., 2001. Annual bedform regime, roughness and flow resistance, Lillooet River, British Columbia. *Geomorphology*, 41(4) 369-390.

Ekes, C. and Hickin, E.J., 2001, Ground penetrating radar facies of the paraglacial Cheekye Fan, southwestern British Columbia, Canada. *Sedimentary Geology*, 143, 199-217.

Paige, A.D. and Hickin, E.J., 2000, Annual bed-elevation regime in the alluvial channel of Squamish River, southwestern British Columbia, Canada. *Earth Surface Processes and Landforms*, 25, 991-1009.

Friele, P., Ekes, C. and Hickin, E.J., 1999, Evolution and internal architecture of Cheekeye Fan near Vancouver, British Columbia. *Canadian Journal of Earth Sciences*, 36, 2023-2050.

Gibson, J. and Hickin, E.J., 1997, Sedimentology of the Squamish River estuary floodplain, southwestern British Columbia. *Sedimentology*, 44, 197-220.

Leclerc, R.F. and Hickin, Edward J. 1997 The internal structure of scrolled floodplain deposits based on ground-penetrating radar, North Thompson River, British Columbia: *Geomorphology*, 21, 17-38.

5.6 Research/Project Funding

Contract/Grant: Research Grant **Awarded:** 2002 **Period:** 2002 - 2006

Project Title: Fluvial processes, geomorphology, and sedimentology of rivers in Western Canada

Funding: NSERC **Type:** External **Annual:** \$30,600 **Total:** \$122,400

Involvement: Principal Investigator

Contract/Grant: Strategic Grant **Awarded:** 2001 **Period:** 2001 - 2005

Project Title: Sediment transport models for lower Fraser River: tools for sustainable management

Funding: NSERC **Type:** External **Annual:** \$127,175 **Total:** \$508,700

Involvement: Joint Investigator **Collaboration:** PI: Mike Church (BC); CIs: Rob Millar (UBC), Ted Hickin (SFU).

Hickin total funding: \$112,400

Institution of Co-Investigator(s): University of British Columbia

Contract/Grant: Research Grant **Awarded:** 2001 **Period:** 2001 - 2002

Project Title: River studies in the Coast Mountains of British Columbia

Funding: Dean of Science **Type:** Internal **Annual:** \$22,000 **Total:** \$22,000

Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 2000 **Period:** 2000 - 2001

Project Title: River Geomorphology and Engineering

Funding: Dean of Science **Type:** Internal **Annual:** \$22,000 **Total:** \$22,000

Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1998 **Period:** 1998 - 2001

Project Title: River studies in the Coast Mountains of British Columbia

Funding: NSERC **Type:** External **Annual:** \$24,000 **Total:** \$96,000

Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1999 **Period:** 1999 - 2000

Project Title: River Geomorphology and Engineering

Funding: Dean of Science **Type:** Internal **Annual:** \$15000 **Total:** \$15000

Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1997 **Period:** 1997 - 1997

Project Title: River Geomorphology and Engineering

Funding: Dean of Science **Type:** Internal **Annual:** \$5000 **Total:** \$5000

Involvement: Principal Investigator

Contract/Grant: Operating Grant **Awarded:** 1995 **Period:** 1995 - 1997

Project Title: River Geomorphology & Engineering

Funding: NSERC **Type:** External **Annual:** \$21500 **Total:** \$64,500

Involvement: Principal Investigator

6. Dr James MacEachern, Associate Professor (Ichnology & Sedimentology)

6.1 Educational Background

1994 Ph.D. Facies Analysis, University of Alberta, Canada

Integrated ichnological-sedimentological models: applications to the sequence stratigraphic and paleoenvironmental interpretation of the Viking and Peace River Formations, West-Central Alberta. (Unpublished). 612 p.

1987 M.Sc. Geology, University of Regina, Canada

Paleoenvironmental interpretation of the Lower Cretaceous Waseca Formation, Upper Mannville Group, Lloydminster area, Saskatchewan. (Unpublished). 237 p.

1982 B. Sc. Hons. Geology, University of Regina, Canada

Lower Cretaceous microtidal estuarine sediments of the Upper Mannville Group, Pikes Peak heavy oil field, Saskatchewan. (Unpublished) 116 p.

6.2 Current Research Interests

Integration of ichnology with sedimentology and genetic stratigraphy (sequence stratigraphy) for the development of refined facies models. My goal is to help to place applied ichnology into the reach of sedimentary facies analysts. The depositional environments I am currently interested in include deltaic successions, highstand and incised shorefaces, estuarine incised valley complexes, and submarine fan systems.

[ichnology, sedimentology, sequence stratigraphy, facies models]

6.3 Graduate Teaching

Semester	Type	Course	Number	Type	Hours	Enrollment
2002-1	Teaching	Anal. Of Island Arc Sediment. Success	EASC 707	Seminar		1
2002-1	Teaching	Sedimentology	EASC 611	Lecture		2
2002-1	Teaching	Advanced Sedimentology	EASC 611	Directed Studies	1.50	2
2002-1	Teaching	Principles of Ichnology	EASC 622	Directed Studies	1.50	1
2001-3	Teaching	Advanced Sedimentology	EASC 611	Directed Studies	6.00	4
2001-1	Teaching	Principles of Ichnology	EASC 622	Directed Studies	1.50	1
2000-1	Teaching	Stratigraphy	EASC 612	Lecture	1.50	1
2000-1	Teaching	Stratigraphy	EASC 612	Laboratory	1.50	1
2000-1	Teaching	Stratigraphy	EASC 612	Directed Studies	0.75	2
1999-3	Teaching	Sedimentology	EASC 611	Lecture	2.00	2
1999-3	Teaching	Sedimentology	EASC 611	Laboratory	2.00	2
1999-3	Teaching	Principles of Ichnology	EASC 622	Lecture	1.50	1
1999-1	Teaching	Stratigraphy	EASC 612	Lecture	2.00	1
1999-1	Teaching	Stratigraphy and Sedimentation	EASC 612	Laboratory	1.50	1
1999-1	Teaching	Studies in Earth Sciences III (Petroleum Geology)	EASC 703	Lecture	2.00	2
1999-1	Teaching	Studies in Earth Sciences III (Petroleum Geology)	EASC 703	Laboratory	1.50	1
1998-3	Teaching	Sedimentology	EASC 611	Lecture	1.50	1
1998-3	Teaching	Sedimentology	EASC 611	Laboratory	1.50	1
1998-3	Teaching	Sedimentology	EASC 611	Lecture	1.50	1
1998-3	Teaching	Studies in Earth Sciences III (Petroleum Geology)	EASC 703	Lecture	1.50	1
1998-3	Teaching	Studies in Earth Sciences III (Petroleum Geology)	EASC 703	Laboratory	1.50	1
1998-1	Teaching	Stratigraphy	EASC 612	Lecture	4.50	3
1998-1	Teaching	Principles of Ichnology	EASC 622	Directed Studies	1.50	1
1998-1	Teaching	Principles of Ichnology	EASC 622	Laboratory	1.50	1
1998-1	Teaching	Principles of Ichnology	EASC 622	Laboratory	1.00	1
1997-3	Teaching	Introduction to Graduate Studies	EASC 600	Directed Studies	0.00	4

Semester	Type	Course	Number	Type	Hours	Enrollment
1997-3	Teaching	Sedimentology	EASC 611	Lecture	7.50	5
1997-3	Teaching	Sedimentology	EASC 611	Laboratory	1.00	5

6.4 Senior Supervisory Duties of a Thesis/Dissertation/or Major Project

Name	Degree	Project/Thesis Title	Status	Began	Completed
Lerette, John	M.Sc.	Ichnology and sedimentology of the Hoadley Barrier Complex, Glauconite Formation, Central Alberta	Active	2002-1	
Hobbs, Travis	M.Sc.	Ichnology and sedimentology of the Falher A and B, and the basal Notikewin Member, West-Central Alberta	Active	2000-3	2003-1
Treptau, Kevin	M.Sc.	Sedimentology and ichnology of the Cedar District Formation, Upper Cretaceous Nanaimo Group, Gulf Islands and Vancouver Island, British Columbia	Active	1999-3	2002-1
Coates, Lorraine	M.Sc.	Ichnological signature of wave- and river-dominated deltas, Dunvegan Formation and Basal Belly River Fm, west-central Alberta	Completed	1997-3	2001-2
Leroux, Michael	M.Sc.	Sedimentologic and ichnologic characterization of reservoir types in a transgressive systems tract, Cretaceous (Albian) Basal Colorado interval, south-central Alberta	Completed	1998-3	2000-3

6.5 Selected Publications

Groenewald, G.H., J. Welman, and J.A. MacEachern, 2001, Vertebrate Burrow Complexes from the Early Triassic Cynognathus Zone (Driekoppen Formation, Beaufort Group) of the Karoo Basin, South Africa, *Palaios* 16, 148-160.

Pemberton, S.G., Zhou, Z., and MacEachern, J.A., 2001, Ichnological studies on tempestites, *Acta Sedimentologica Sinica*, v. 18 489-494.

Pemberton, S.G., Zhou, Z., and MacEachern, J.A., 2001, Discussion on preservational potential of event beds. *Acta Sedimentologica Sinica*, v. 19, p. 7-12.

Pemberton, S.G., Zhou, Z., and MacEachern, J.A., 2001, Modern ecological interpretation of opportunistic (r-selected) trace fossils and equilibrium (K-selected) trace fossils. *Acta Palaeontologica Sinica*, v. 40, p. 134-142.

Stelck, C.R., MacEachern, J.A., and Pemberton, S.G., 2000, A calcareous foraminiferal faunule from the Upper Albian Viking Formation, Giroux Lake and Kaybob North and fields, northwestern Alberta: implications for regional biostratigraphic correlation, *Canadian Journal of Earth Science*, v. 37, 1389-1410.

MacEachern, J.A. and J.A. Burton, 2000, Firmground Zoophycos in the Lower Cretaceous Viking Formation, Alberta: A distal expression of the Glossifungites Ichnofacies, *Palaios*, v. 15, p. 387-398

Pemberton, S.G., MacEachern, J.A., Gingras, M.K., and Zhang, J., 2000, Significance of ichnofossils to genetic stratigraphy. *Science in China, Series D* 30: 264-278.

MacEachern, J.A., C.R. Stelck. and S.G. Pemberton, 1999, Marine and marginal marine mudstone deposition: Paleoenvironmental interpretations based on the integration of ichnology, palynology and foraminiferal paleoecology, in Bergman, K.M. and Snedden, J.W. (eds.), *Isolated Shallow Marine Sand Bodies: Sequence Stratigraphic and Sedimentologic Interpretation*, SEPM Special Publication 64, 205-225.

MacEachern, J.A., B.A. Zaitlin and S.G. Pemberton, 1999, Coarse-grained, shoreline-attached, marginal marine parasequences of the Viking Formation, Joffre Field, Alberta Canada, in Bergman, K.M. and Snedden, J.W. (eds.), *Isolated Shallow Marine Sand Bodies: Sequence Stratigraphic and Sedimentologic Interpretation*, SEPM Special Publication 64, 273-296.

MacEachern, J.A., B.A. Zaitlin and S.G. Pemberton, 1999. A sharp-based sandstone succession of the Viking Formation, Joffre Field, Alberta, Canada: Criteria for recognition of transgressively incised shoreface complexes. *Journal of Sedimentary Research*, v. 69, p. 876-892.

MacEachern, J.A., B.A. Zaitlin and S.G. Pemberton, 1998. High-resolution sequence stratigraphy of early transgressive deposits, Viking Formation, Joffre Field, Alberta Canada. *American Association of Petroleum Geologists Bulletin*, v. 82, p. 729-756 .

Gingras, M.K., J.A. MacEachern, S.G. Pemberton. 1998. A comparative analysis of the ichnology of wave- and river-dominated allomembers of the Upper Cretaceous Dunvegan Formation. *Bulletin of Canadian Petroleum Geology*, v. 46, p. 51-73.

MacEachern, J.A. and S.G. Pemberton. 1997. Ichnology: Biogenic utility in genetic stratigraphy. in J. Wood and B. Martindale (eds.), *Sedimentary Events and Hydrocarbon Systems: Core Conference*, Canadian Society of Petroleum Geologists - Society of Economic Paleontologists and Mineralogists 1997 Joint Convention (Calgary), p. 387-412.

Pemberton, S.G. and J.A. MacEachern. 1997. The ichnological signature of storm deposits: the use of trace fossils in event stratigraphy. In: C.E. Brett (ed.), *Paleontological event horizons: ecological and evolutionary implications*. Columbia University Press, p. 73-109.

Pemberton, S.G., J.A. MacEachern and Buatois, L.A. 1997. Criterios ichnológicos en el reconocimiento des limites estratales claves. *Boletin de la Sociedad Venezolana de Geologos* 22: p. 7-32..

6.6 Research/Project Funding

Contract/Grant: Operating Grant **Awarded:** 2000 **Period:** 2000 - 2002

Project Title: Integrated Ichnological-Sedimentological Clastic Facies Models in a Sequence Stratigraphic Framework

Funding: NSERC (Operating Grant 184293-00) **Type:** External **Annual:** \$19,300 **Total:** \$38,600

Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1998 **Period:** 1998 - 1999

Project Title: Mannville Incised Valley Project (Completion)

Funding: PanCanadian Petroleum Co. Ltd. **Type:** External **Annual:** \$15,000 **Total:** \$15,000

Involvement: Principal Investigator

Institution of Co-Investigator(s): Zaitlin: PanCanadian Petroleum Co. Ltd.

Contract/Grant: Operating Grant **Awarded:** 1996 **Period:** 1996 - 1999

Project Title: Integrated Ichnological-Sedimentological Facies Models

Funding: NSERC (Operating Grant 184293) **Type:** External **Annual:** \$18,000 **Total:** \$72,000

Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1997 **Period:** 1997 - 1998

Project Title: Research Grant: Ichnology, Sedimentology and Sequence Stratigraphy of the Viking Fm, Willesden Green Field

Funding: Numac Energy Inc. Type: External Annual: \$6,000 Total: \$6,000
 Involvement: Principal Investigator

Contract/Grant: Research Grant Awarded: 1997 Period: 1997 - 1998

Project Title: Mannville Incised Valley Project (Continuation)

Funding: PanCanadian Petroleum Co. Ltd. Type: External Annual: \$20,000 Total: \$20,000

Involvement: Principal Investigator

Institution of Co-Investigator(s): Zaitlin: PanCanadian Petroleum Ltd.

Contract/Grant: Research Grant Awarded: 1996 Period: 1996 - 1998

Project Title: Application of Ichnology to Sedimentology and High Resolution Sequence Stratigraphy II: Determination of Animal-Sediment Relationships in Ancient Fluvial/Tidal Dominated Estuarine Incised Valley Deposits

Funding: Simon Fraser University PRG 96-2 Type: Internal Annual: \$12,000 Total: \$12,000

Involvement: Principal Investigator

Contract/Grant: Research Grant Awarded: 1995 Period: 1995 - 1997

Project Title: Mannville Incised Valley Project

Funding: PanCanadian Petroleum Co. Ltd. Type: External Annual: \$40,000 Total: \$80,000

Involvement: Principal Investigator

Institution of Co-Investigator(s): Zaitlin: PanCanadian Petroleum Co. Ltd.

7. Dr Dan Marshall, Assistant Professor (Geochemistry)

7.1 Educational Background

1995 D.Sc. Geology, Université de Lausanne, Switzerland
 1990 M.Sc. Geology (with Distinction), Carleton University, Canada
 1985 B.Sc. Geology (minor Computer Science), Carleton University, Canada

7.2 Current Research Interests

My research interests are in metamorphic petrology, aqueous geochemistry, ore deposits and tectonics. A good deal of my research has been focused upon applying various methods of pressure, temperature and age determinations to economic and sub-economic ore deposits. These data have been used to establish tectonic histories. In addition to the regional metamorphic rocks studied to obtain P-T paths, ore deposits offer a rich source of mineral equilibria for pressure-temperature terminations as there is an extensive body of thermodynamic data for ore minerals. Additionally, most ore deposits commonly possess some variety of alteration halo comprised of metamorphic silicates, carbonates and/or oxides that may be also used to derive pressure, temperature, time and fluid chemistry constraints [Geochemistry, Fluid Inclusions, Petrology, Computer Modelling of Crustal Fluids, Analytical Instrumentation (SEM, EDS, XRD, XRF, Raman ...)]

7.3 Graduate Teaching

Semester	Type	Course	Number	Session	Type	Hours	Enrollment
2002-3	Teaching	Volcanology	EASC 620	G01.00	Lecture		1
2001-2	Teaching	Plate Margins	EASC621	D01.00	Directed Studies	1.50	1
2001-1	Teaching	ST-Earth SciencesIIi	EASC703	G02.00	Directed Studies	1.50	1
2000-3	Teaching	ST-Easc III	EASC703		Directed Studies	1.50	1
1999-3	Teaching	Introduction to Graduate Studies Co-taught with Thorkelson & Ward	EASC600		Seminar	0.00	12

7.4 Senior Supervisory Duties of a Thesis/Dissertation/or Major Project

Name	Degree	Project/Thesis Title	Status	Began	Completed
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Name	Degree	Project/Thesis Title	Status	Began	Completed
Hubbard, Laura	M.Sc.	Petrography and Geochemistry of the Alteration at the Giant Mine. Yellowknife, N.W.T.	Active	2001-2	
Ghosh, Sanghamitra	M.Sc.	Tectonic evolution of the Nicola Horst, BC.	Active	2000-3	2003-1
Brannstrom, Brenda	B.Sc.	Petrology and Geochemistry of a new Greenstone Belt, MWT, Canada	Completed	2000-1	2000-1

7.5 Selected Publications

Groat L.A., Baker D.W., Taylor R.P, Marshall D.D., Fallick A.E. and Sherlock R. (in press) Sapphire-bearing ultramafic lamprophyre dike at Yogo Gulch, Montana: Trace element geochemistry and implications for flat-slab plate tectonics. *American Mineralogist*.

Marshall D., Simandl G. and Voormeij D. (in press) Fluid Inclusion Evidence for the Genesis of the Mt. Brussilof Magnesite Deposit. *Engineering and Mining Geology*. (accepted Aug 15, 2002)

Groome W.G., Thorkelson D.J., Friedman R.M., Massey N.W.D., Marshall D.D. (in press) Eocene Magmatism in the Leech River Complex: Evidence for spreading ridge subduction and slab window magmatism. *Geological Society of America Special Publication*.

Marshall D., Groat L., Giuliani G., Murphy D., Matthey D., Ercit T.S., Wise M., Wengzynowski W. and Eaton W.D. (2003) Pressure, temperature and fluid conditions during emerald precipitation, southeastern Yukon, Canada: Fluid inclusion and stable isotope evidence. *Chemical Geology*, v. 194, p. 187-199.

Groat L.E., Marshall D., Giulian, G., Murphy D.C., Piercey S.J., Jambor J.L., Mortensen J.K., Ercit T.S., Gault R.A., Matthey D.P., Schwarz D., Wise M.A., Wengzynowski W. and Eaton D.W. (2002) Mineralogical and geochemical study of the Regal Ridge Showing emerald, Southeastern Yukon. *Canadian Mineralogist*, v. 40, p. 1313-1338.

Marshall D. and Watkinson D.H. (2000) The Cobalt Mining District: Silver Sources, Transport and Deposition. *Exploration and Mining Geology*, v. 9, p. 81-90.

Marshall D., Watkinson D., Farrow C., Molnar F. and Fouillac A-M. (1999) Multiple Fluid Generations in the Sudbury Igneous Complex: Fluid Inclusion, Ar, O, H, Rb and Sr Evidence. *Chemical Geology*, v. 154, p. 1-19.

Marshall D., Meisser.N. and Taylor R.P. (1998) Fluid Inclusion, Stable Isotope and Ar-Ar Evidence for the Age and Origin of Gold-bearing Quartz Veins at Mont Chemin, Switzerland. *Mineralogy and Petrology*, v. 62, p. 147-165.

Marshall D., Kirschner D., Hunziker J. and Pfeiffer H-R. (1998) A Pressure-Temperature-Time Path for the N-E Mont-Blanc Massif: Fluid Inclusion, Isotopic and Thermobarometric Evidence. *European Journal of Mineralogy*, v. 10, p. 1227-1240.

Marshall D., Kirschner D. and Bussy F. (1997) A Variscan Pressure-Temperature-time path for the N.E. Mont Blanc massif. *Contributions to Mineralogy and Petrology*, v. 126, p. 416-428.

7.6 Research/Project Funding

Contract/Grant: Operating Grant **Awarded:** 1999 **Period:** 1999 - 2003

Project Title: Pressure, temperature, time and fluid compositional constraints for ore deposition at Sudbury, Cobalt and Separation Rapids, Ontario.

Funding: NSERC **Type:** External **Annual:** \$23,100 **Total:** \$92,400

Involvement: Principal Investigator

Contract/Grant: Equipment Grant **Awarded:** 2000 **Period:** 2000 - 2002

Project Title: Mass Spectrometers for geochronological and stable isotope studies

Funding: NSERC, UBC Blusson Fund, BC Knowledge Fund **Type:** External **Total:** 2,633,700

Involvement: Joint Investigator
Institution of Co-Investigator(s): UBC, SFU, UVIC

Contract/Grant: Equipment Grant **Awarded:** 2000 **Period:** 2000 - 2001
Project Title: Hardware and Software Upgrade of SX-50 microprobe.
Funding: NSERC **Type:** External **Total:** 97,400
Involvement: Joint Investigator
Institution of Co-Investigator(s): UBC

Contract/Grant: Equipment Grant **Awarded:** 2000 **Period:** 2000 - 2000
Project Title: Infrared Microthermometry System
Funding: NSERC **Type:** External **Annual:** 78,725 **Total:** 78,725
Involvement: Principal Investigator
Institution of Co-Investigator(s): UBC

Contract/Grant: Research Grant **Awarded:** 1999 **Period:** 1999 - 2000
Project Title: Pressure, temperature and fluid conditions responsible for the deposition of a Gem Quality Water Sapphire (Iolite) in the core metamorphic complex, Revelstoke area, BC.
Funding: BC Provincial Geological Survey **Type:** External **Annual:** \$2,500 **Total:** \$2,500
Involvement: Principal Investigator
Institution of Co-Investigator(s): BC Provincial Geological Survey

Contract/Grant: Research Grant **Awarded:** 1999 **Period:** 1999 - 2000
Project Title: Rb-Sr, Pb, C, O, S isotopic and fluid inclusion studies in low-temperature-vein systems, with applications to low temperature metal transport, intra-plate tectonics and pressure-temperature-time uplift paths.
Funding: President's Research Grant **Type:** Internal **Annual:** \$5,500 **Total:** \$5,500
Involvement: Principal Investigator

8. Dr Peter Mustard, Associate Professor (Stratigraphy and Sedimentology)

8.1 Educational Background

1990 Ph.D. Earth Sciences, Carleton University, Ottawa, Canada
Upper Proterozoic - Lower Cambrian sedimentary rocks of the Mount Harper Group, Ogilvie Mountains, Yukon
1985 M.Sc. Geology, Carleton University, Ottawa, Canada
Sedimentology of the lower Gowganda Formation Coleman Member (Early Proterozoic) at Cobalt, Ontario
1981 B.Sc. Geology, University of Calgary, Canada

8.2 Current Research Interests

Evolution and tectonic setting of North American Cordillera sedimentary basins. Current studies involve sedimentary basins marginal to Strait of Georgia, including Greater Vancouver and basins in the B.C. interior relevant to paleolatitude controversies during late Cretaceous evolution of the Cordillera.

8.3 Graduate Teaching

Semester	Type	Course	Number	Session	Type	Hours	Enrollment
2003-1	Teaching	Tectonics of Sedimentary Basins	EASC 618	G01.00	Lecture		3
2002-3	Teaching	Geoscience Education	EASC 705	G01.00	Special Topics		1
2001-2	Teaching	ST-Sedimentology	EASC703		Directed Studies	1.50	1
2001-2	Teaching	ST-Sedimentology	EASC703	G01.00	Directed Studies	1.50	1
2000-3	Teaching	Tectonics of Sedimentary Basins	EASC618		Lecture	2.00	2
2000-3	Teaching	Tectonics of Sedimentary Basins	EASC618		Directed Studies	1.50	2
1999-1	Teaching	Tectonics of Sedimentary Basins	EASC618		Lecture	3.00	3

Semester	Type	Course	Number	Session	Type	Hours	Enrollment
1998-3	Teaching	Special Topics in Earth Science III	EASC703		Directed Studies	1.50	1
1997-3	Teaching	Tectonics of Sedimentary Basins	EASC618		Lecture and laboratory	5.00	1

8.4 Senior Supervisory Duties of a Thesis/Dissertation/or Major Project

Name	Degree	Project/Thesis Title	Status	Began	Completed
Johnstone, Patrick	M.Sc.	Geology of the lower Nanaimo Group southern margin, B.C. and Washington State	Active	2003-1	
Beatty, Tyler	M.Sc.	Biostratigraphy of the Harper Ranch Group, central British Columbia	Active	2001-2	
Gilley, Brett	M.Sc.	Facies Architecture of the early Tertiary Huntingdon Formation, southwest British Columbia	Active	2001-2	
Mackie, Daniel	M.Sc.	Structural and hydrogeologic analysis of fracture and minor fault systems, Upper Cretaceous Nanaimo Group of the outer Gulf Islands, British Columbia	Completed	1999-3	2002-1
Treptau, Kevin	M.Sc.	Sedimentology and Ichnology of the Upper Cretaceous Cedar District Formation, Nanaimo Group, British Columbia	Completed	1999-3	2002-2
Katnick, Deanne	M.Sc.	Geology of the Upper Cretaceous Nanaimo Group on Hornby and Denman Islands, British Columbia	Completed	1998-2	2001-1
Haskin, Michelle	M.Sc.	Stratigraphic affinity of Upper Cretaceous volcanic rocks in the Churn Creek / Gang Ranch area, south-central British Columbia	Completed	1998-2	2000-3
Brannstrom, Brenda Marie,	B.Sc.	Chemical Characteristics of Archean volcanic rocks from the Snare River Area (NTS 85O/13), S.W. Slave Province, NWT.	Completed	2000-1	2000-1
Breitsprecher, Katrin	M.Sc.	G.I.S. compilation of the Upper Cretaceous Nanaimo Group, British Columbia	Transferred	1998-3	1999-1

8.5 Selected Publications

Haskin, M.L., Enkin, R.J., Mahoney, J.B., Mustard, P.S. and Baker, J. 2003. Deciphering shallow paleomagnetic inclinations: 1. Implications from correlation of Albian volcanic rocks along the Insular/Intermontane Superterrane boundary in the southern Canadian Cordillera, *Journal of Geophysical Research, Solid Earth*. v. 108(B4), p. 2105-2185.

Katnick, D.C. and Mustard, P.S. 2003. Geology of Denman and Hornby islands, British Columbia: implications for Nanaimo Basin evolution and formal definition of the Geoffrey and Spray formations, Upper Cretaceous Nanaimo Group. *Canadian Journal of Earth Sciences*, v. 40, p. 375-393.

Rowe, C.A., Mustard, P.S., Mahoney, J.B., and Katnick, D.C., 2002, Oriented elastic dike swarms as indicators of paleoslope? An example from the Upper Cretaceous Nanaimo Group, Canada, *Journal of Sedimentary Research*, v. 72, no. 1, p. 197-205.

Enkin, R.J., Baker, J., and Mustard, P.S., 2001, Paleomagnetism of the late Cretaceous Nanaimo Group, Southwestern Canadian Cordillera, *Canadian Journal of Earth Sciences*, 38(10) 1403-1422.

Katnick, D.C., and Mustard, P.S., 2001. Geology of Denman and Hornby Islands, British Columbia (92F/7E 10), B.C. Geological Survey, Geoscience Map 2001-3, 1:50,000 scale, 1 sheet.

Evenchick, C.A., Mustard, P.S., Greig, C.J., Porter, J.S., McNeill, P.D., 2000. Geology, Bowser Lake, (104A) British Columbia. Geological Survey of Canada, Open File 3918, scale 1:250,000.

Mahoney, J.B., Mustard, P.S., Haggart, J., Friedman, R.M., Fanning, C.M. McNicoll, V.J., 1999. Archean zircon in Cretaceous strata of the western Canadian Cordillera: the "Baja B.C." hypothesis fails a "crucial test". *Geology*, v 27, p. 195-198.

Mustard, P.S., Clague, J.J., Hickson, C.J., Jackson, Jr., L.E., Lutemauer, J.L., Monger, J.W.H., Ricketts, B.D., Turner, R.J.W., and Woodsworth, G.J., 1998. Geology and geohazards of the greater Vancouver region. in *Urban Geology of Canadian Cities*; (eds.) P.F. Karrow and O.L. White, Geological Association of Canada, Special Paper No. 42, p. 39-70.

Mustard, P.S. and van der Heyden, P., 1997. Geology of Tatla Lake (92N/15) and Bussel Creek (92N/14) map areas; in *Interior Plateau Geoscience Project: Summary of Geological, Geochemical and Geophysical Studies*; GSB paper 1997-2 and GSC Open File 3448, p. 103-122.

Mustard, P.S., and Roots, C.F., 1997, Stratigraphy and tectonic setting of the upper Proterozoic Mount Harper Group, Ogilvie Mountains, Yukon; *Geological Survey of Canada, Bulletin 492*, 92 p. 1997

8.6 Research/Project Funding

Contract/Grant: Research Grant **Awarded:** 2003 **Period:** 2003 - 2007

Project Title: Sedimentology, stratigraphy and tectonic significance of selected western Cordillera sedimentary basins

Funding: NSERC **Type:** External **Annual:** 23, 890 **Total:** 95,560

Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 2000 **Period:** 2000 - 2003

Project Title: Sedimentology, stratigraphy and tectonic significance of selected western Cordillera sedimentary basins

Funding: NSERC **Type:** External **Annual:** 26,300 **Total:** 78,900

Involvement: Principal Investigator

Contract/Grant: 3 infrastructure/equipment grants, 1 proposal **Awarded:** 2000 **Period:** 2000 - 2001

Project Title: Pacific Centre for Isotopic and Geochemical Research

Funding: Canadian Foundation for Innovation (\$1,053,000); UBC Stuart Blussion Reserach Fund (\$527,700); B.C.

Knowledge Fund (\$1053,000) **Type:** External **Annual:** 2,633,700 **Total:** 2,633,700

Involvement: Joint Investigator **Collaboration:** co-investigator with 13 others in a research consortium which will share several new analytical instruments, plus preparation laboratories; all to be housed at at UBC

Institution of Co-Investigator(s): UBC, SFU, UVic, U or Alberta

Contract/Grant: Conference Grant **Awarded:** 2000 **Period:** 2000 - 2000

Project Title: Grant to support conference expenses for the Geological Society of America, Cordilleran Section Annual Meeting, April 27-29, 2000, Vancouver, B.C.

Funding: Geological Survey of Canada **Type:** External **Annual:** \$5000 **Total:** \$5000

Collaboration: General chair for conference

Contract/Grant: Conference Grant **Awarded:** 1999 **Period:** 1999 - 2000

Project Title: Conference Grant to support pre-conference expense for the Geological Society of America, Cordilleran Section Annual Meeting, April 27-29, 2000, Vancouver, B.C.

Funding: SFU VP Academic Conference Fund **Type:** Internal **Annual:** 5000 **Total:** 5000

Collaboration: General Chair for conference

Contract/Grant: Research Grant **Awarded:** 1996 **Period:** 1996 - 2000

Project Title: Provenance and stratigraphic studies of sedimentary basins, southwestern British Columbia

Funding: NSERC **Type:** External **Annual:** \$24,465 **Total:** \$97,860

Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1996 **Period:** 1996 - 1998

Project Title: Provenance and stratigraphic studies of sedimentary basins, southwestern British Columbia

Funding: Presidents Research Grants Fund, Simon Fraser University **Type:** Internal **Annual:** 8000 **Total:** \$8,000

Involvement: Principal Investigator

9. Dr Michael C. Roberts, Professor (Quaternary Geology and Geomorphology)

9.1 Educational Background

1992 P.Geo. Geotechnics, Assoc. Prof. Engineers & Geoscientists of BC, Canada
1966 Ph.D. Geography, University of Iowa, USA
1965 M.A. Physical Geography, University of Toronto, Canada
1960 B.Sc. Geography, University College London, United Kingdom

9.2 Current Research Interests

A subsurface analysis (seismic & drill cores) of the channel separating Point Roberts from the Fraser delta.

GPR analysis of periglacial slope deposits in the Mittelgebirge of central Germany.

The documentation of tephra removal from an Allerød landscape: Eifel Volcanic district, Germany

BEACH RIDGE SYSTEMS: A project is underway in Boundary Bay Park investigating the accretion of beach ridges, and their facies.

The analysis of the sedimentology and aggradation styles of beach ridges forming cusped forelands (Dungeness, UK; Darss, Germany).

9.3 Graduate Teaching

Semester	Type	Course	Number	Session	Type	Hours	Enrollment
2002-1	Teaching	Quaternary Geology	EASC617		Directed Studies		4
1998-1	Teaching	Quaternary Geology	EASC617		Directed Studies	3.00	2
1998-1	Teaching	Directed Readings	GEOG791		Directed Studies	2.00	1
1997-3	Teaching	Spec.Topics Easc I	EASC701		Directed Studies	0.50	1
1997-1	Teaching	Environmental Geosci	EASC619		Lecture	2.00	1

9.4 Senior Supervisory Duties of a Thesis/Dissertation/or Major Project

Name	Degree	Project/Thesis Title	Status	Began	Completed
McCuaig, Shirley	Ph.D.		Completed	1995-3	2000-1
Engels, Simone	M.Sc.		Completed	1997-3	1999-2
Dixon-Warren, Antigone	M.Sc.		Completed	1996-3	1998-2
Leboe, Elizabeth	M.Sc.		Completed	1994-3	1997-1
Turner, Douglas	M.Sc.		Completed	1990-3	1995-2
Vanderburgh, Sandy	Ph.D.		Completed	1987-3	1993-2
Rolls, J	M.R.M.		Completed	1990-3	1992-2
Cameron, V	M.A.		Completed	1984-3	1989-3
Tippett, Eric	M.R.M.		Completed	1984-3	1988-3
Jol, H	M.Sc.		Completed	1986-3	1988-2
Williams, H	Ph.D.		Completed	1983-1	1988-2
Morningstar, O	M.Sc.		Completed	1985-3	1987-3
Baker, D	M.R.M.		Completed	1984-1	1987-2
Fuller, Ted	M.Sc.		Completed	1983-3	1986-3
Tomich, R	M.R.M.		Completed	1980-3	1986-2

9.5 Selected Publications

Voelkel, J., Leopold, M. & Roberts, M.C. 2001. The radar signatures and age of periglacial slope deposits in the Central European Highlands of Germany. *Permafrost and Periglacial Processes* 12(4): 379-387

Roberts, M.C., & McCuaig, S., 2001, Geomorphic response to the sudden blocking of a fluvial system: Aiyansh Lava Flow, northwest British Columbia. *Canadian Geographer* 45(2):319-323

Vanderburgh, S., Roberts, M.C., Peterson, C.D., Jol, H.M., & Phipps, J.B. 2001. 1998 drilling program on the Columbia River littoral cell; SW Washington coastal erosion study. In Gelfenbaum, G., & Kaminsky, G.M. (eds) Southwest Washington coastal erosion workshop report 1998. United States Geological Survey, Open File Report 99-0524, p.51-54.

Jol, H.M., Peterson, C.D., Roberts, M.C., Vanderburgh, S., & Phipps, J.B. 2001. Drill core correlation and ground penetrating radar profiles. In Gelfenbaum, G., & Kaminsky, G.M. (eds) Southwest Washington coastal erosion workshop report 1998. United States Geological Survey, Open File Report 99-0524, p.55-57.

Roberts, M.C., Vanderburgh, S., & H.Jol, 2000, The geomorphology and radar facies of the seepage face of the Brookwood aquifer, BC. A chapter in 'Aquifer delineation, Fraser Lowland and Delta, BC: mapping, geophysics and ground water modelling' ed. B. Ricketts, Geol.Surv. Canada. Bulletin 552, pp.95 - 102.

Roberts, M.C. 2000. Professional Registration: History Continues. Newsletter of the Canadian Geomorphology Research Group, Number 13, pp.5-6

Pullan, S.E., Good, R.L., Jarvis, K., Roberts, M.C. & S. Vanderburgh, 2000, Application of shallow seismic reflection techniques to subsurface structural mapping, lower Fraser Valley, BC. A chapter in 'Aquifer delineation, Fraser Lowland and Delta, BC: mapping, geophysics and ground water modelling' ed. B. Ricketts, Geol. Surv.Canada. Bulletin 552, pp. 49 - 74.

Roberts, M.C. & Jol, H.M., 2000. The sedimentary architecture and geomorphology of a cusped spit: Tsawwassen, British Columbia. Regensburger Geographische Schriften, 33: 141 - 156

McCuaig, S.J., & Roberts, M.C., 1999. Surficial geology drilling results: Nass Valley, British Columbia. Geological Survey of Canada, Paper 1-1999A, p.25 - 34.

Pullan, S.E., Hunter, J.A., Jol, H.M., Roberts, M.C., Burns, R.A., Good, R.L., and J.B. Harris. 1998. Seismostratigraphic investigations of the southern Fraser River delta. In 'Geology and natural hazards of the Fraser River delta, BC' (eds. Clague, J.J., Luternauer, J.L., and D. Mosher), Geological Survey of Canada, Bulletin 525, pages 91 - 122.

Roberts, M.C. & O.R. Morningstar, 1998, Floodplain formation in a wandering gravel-bed river: Lower Fraser River, BC, Canada. A chapter in 'Festschrift Wolfgang Schirmer: Geschichte aus der Erde,' A. Iking (ed.). Munster, Lit Verlag. pp.63 -70.

Roberts, M.C., Bravard, J-P., & H. Jol, 1997, Radar signatures and structure of an avulsed channel: Rhone River, Aoste, France. Journal of Quaternary Science, 12(1) 35-42.

9.6 Research/Project Funding

Contract/Grant: Operating Grant **Awarded:** 1997 **Period:** 1997 - 2000

Funding: NSERC **Total:** \$40,000

Contract/Grant: Contract **Awarded:** 1998 **Period:** 1998 - 1999

Project Title: USGS Southwest Washington Beach Erosion Study

Funding: US Geological Survey and State of Washington **Type:** External **Total:** 29,000

Involvement: Joint Investigator **Collaboration:** Supervised, assisted and managed the drilling program.

Institution of Co-Investigator(s): Portland State University

Contract/Grant: Research Grant **Awarded:** 1998 **Period:** 1998 - 1999

Project Title: Quaternary geology and geomorphology of the Nass River Valley.

Funding: Geological Survey of Canada **Type:** External **Annual:** 11,000 **Total:** 11,000

Involvement: Principal Investigator **Collaboration:** I applied for the grant to fund drilling in the Nass Valley for my Ph.D. student: Shirley McCuaig. It funded 4 people and the operation of the drill rig for one month.

Institution of Co-Investigator(s): SFU

Contract/Grant: Proposal Grant **Awarded:** 1997 **Period:** 1997 - 1998

Project Title: FRBC Chair Stage II Proposal Support

Funding: FRBC **Total:** \$5,840

10. Dr Douglas Stead, Professor & FRBC Chair (Engineering Geology)

10.1 Educational Background

1984 Ph.D. Mining Engineering, University of Nottingham, United Kingdom
An Evaluation of the Factors Governing the Stability of Surface Coal Mine Slopes
1976 M.Sc. Engineering Geology and Geotechnics, University of Leeds, United Kingdom
A Comparison of the Quickclays of Canada and Scandinavia
1973 B.Sc. Geology, University of Exeter, United Kingdom

10.2 Current Research Interests

Characterization of forest-related landslides in British Columbia using an integrated groundwater- slope modelling approach; The development and verification of risk assessment techniques applicable to forest terrains; Modelling of stress-induced rock fracture in surface and underground excavations using coupled finite element-discrete element codes; An integrated acoustic emission-numerical modelling investigation of brittle rock fracture; The characterization of landslide failure mechanisms using integrated numerical modelling; Three dimensional modelling of underground excavations

10.3 Graduate Teaching

Semester	Type	Course	Number	Session	Type	Hours	Enrollment
2003-1	Teaching	Directed Readings	EASC710	G01.00	Seminar		1
2002-3	Teaching	Geotechnics	EASC 706	G01.00	Special Topics		1
2002-3	Teaching	Resource Geotechnics	EASC 704	G01.00	Special Topics		2
2002-1	Teaching	Directed Studies: Resource Geotechnics	493.3	D01	Seminar	3.00	1
2001-3	Teaching	Rock/soil Engineer.	EASC313	D01.00	Lecture	4.00	19

10.4 Senior Supervisory Duties of a Thesis/Dissertation/or Major Project

Name	Degree	Project/Thesis Title	Status	Began	Completed
Boulton, Nichole	M.Sc.	Characterisation of the Copper Cliff Debris Flow	Active	2002-3	
Kinakin, Derek	M.Sc.	The application of GIS in geotechnical engineering	Active	2002-3	
Scott Paddington,	M.Sc.	The characterisation of gentle over steep slopes in BC forest terrains	Active	2001-2	

10.5 Selected Publications

Eberhardt, E., Kaiser, P.K. and Stead, D. Numerical analysis of progressive failure in natural rock slopes. In EUROCK 2002. Proc of the ISRM International Symposium on Rock Engineering for Mountainous Regions, Funchal, Madeira, Eds. de Gama, C. and Sousa, L. P145-153

S. Paddington, D. Stead and D.M. Allen 2002. The influence of groundwater on the stability of forest slopes in British Columbia. Proc. 55th Canadian Geotechnical Conf., Ground and Water: Theory to Practice. Niagara. October 20 - 23 2002, page

D. Stead, E. Eberhardt and J. Coggan. 2002. Numerical analysis of rock slopes: Incorporating the effects of groundwater. Proc 55th Canadian Geotechnical Conf. Niagara Falls., p665-672

Eberhardt, E., Stead, D., Coggan, J. and Willenberg, H. 2002. An integrated numerical analysis approach applied to the Randa Rockslide. 1st European Landslide Symposium, Prague, 2002, p355-362

Stead, D and Coggan, J.C. Total Slope Failure Analysis: Extended Abstract, p4., NATO conference

Benko, B. and Stead, D. 2002. The factors affecting landslides in forest terrain, coastal British Columbia. Proc. 1st European Landslide Symposium, Prague, 2002, 7pp

Stead, D. 2002. Book Review, Dynamics of Rockslides and Rockfalls. Erissmand and Abele. Springer Verlag. 315pp. Engineering Geology.

D. Stead D., J.S. Coggan. J.H. Howe and D.M. Pascoe. 2002. Application of hazard and risk assessment techniques to quarry slopes. Geological Society of London Special Publication, Extractive Industry Geology, Geological Society Publishing House, London.

A.J. Beer, D.Stead and J. Coggan. 2002 A critical assessment of discontinuity roughness characterization. Rock Mechanics and Rock Engineering.

Coggan J.S., Pine R.J and Stead D. (2001). A proposed methodology for rockfall risk assessment along coastlines. Geoscience in south-west England, 10, part 2, 190-194.

L.H.I. Meyer , J.S. Coggan and D. Stead. 2001. Three-dimensional modelling of sequential tunnel Advance. 2nd Symposium on FLAC and Numerical Modelling in Geomechanics, Billaux et al. (eds), Swets and Zeitlinger, p382-390, Lyons, France.

D.Stead, E. Eberhardt and J. S. Coggan. 2001. Advanced numerical techniques in rock slope stability analysis – Applications and limitations. In UEF International Conference on Landslides - Causes, Impacts and Countermeasures, Davos, Switzerland. Edited by M. Kühne, H.H. Einstein, E. Krauter, H. Klapperich and R. Pöttler, Verlag Glückauf GmbH, Essen, 615-624.(PDF of paper Selected for inclusion on RocScience WWW page)

J. S. Coggan, D. Stead and J. H. Howe. 2001. Application of Surveying Techniques for Monitoring and Appraisal of Excavated China Clay Slopes Proc.10th FIG Int. Symp. on Deformation Measurement, Calif.,p240-249.

D. Stead, J.S. Coggan and J.H. Howe. 2001. Engineering geology of china clay slopes. Journal of Geoscience in South West England, Vol.10,p1-5.

E. Eberhardt, D. Stead and Z. Szczepanik. 2000. Laboratory testing of stress-induced brittle fracture damage through incremental loading. GeoEng 2000. Proceedings of the International Conference on Geotechnical & Geological Engineering, November 2000, Melbourne, Australia. 6pp.

B. Le Gall, J.-J. Tiercelin, J-P Richert, P. Gente, N. Sturchio, D. Stead and C. Le Turdu. 2000. A morphotectonic study of an extensional fault zone in a magma-rich rift: the Baringo Trachyte Fault System, central Kenya Rift. Tectonophysics, 320:2. Pp87-106.

D. Stead, B. Benko, E. Eberhardt and J. Coggan 2000. Mechanisms of failure of Complex Landslide: A Numerical Modelling Perspective. In "Landslides in Research, Theory and Practice" (Eds) E. Bromhead, N. Dixon and M-L Ibsen. Proc. 8th International Symposium on Landslides, Cardiff, Vol 3, 1401-1406.

J. S. Coggan, D. Stead and J.H. Howe. 2000.Characterization of a Structurally Controlled Flowslide in a Kaolinised Granite Slope. In "Landslides in Research, Theory and Practice". (Eds) E. Bromhead, N. Dixon and M-L Ibsen. Proc. 8th International Symposium on Landslides, Cardiff, Vol 1, 299-304.

D. Stead, E. Eberhardt and Z. Szczepanik 2000. Brittle rock fracture and progressive damage in potash. Proc. 8th World Salt Symposium. The Hague. Netherlands. May 2000, (Ed) R.M. Geertman. V. 1, p337-342

R. K. .Shail, D.Stead and J. Coggan.2000. Mechanisms and modelling of Coastal landslides on Cornwall. Proc. Ussher Society/SW Geological Society. (Extended Abstract and presentation)

E. Eberhardt, D. Stead and B. Stimpson. 1999. The influence of mineral composition on crack initiation stress thresholds in granite. 9th ISRM Congress, Paris.

E. Eberhardt, D. Stead, and B. Stimpson. 1999. Quantifying Progressive Pre-Peak Brittle Fracture Damage in Rock During Uniaxial Compression. International Journal of Rock Mechanics and Mining Sciences. Vol. 36: 361-380.

E. Eberhardt, D. Stead and B. Stimpson. 1999. Effects of sample disturbance on the stress-induced microfracturing characteristics of brittle rock. Canadian Geotechnical Journal.

E. Eberhardt, B. Stimpson and D. Stead 1999. Effects of Grain Size on the Initiation and Propagation Thresholds of Stress-induced Brittle Fractures. *Rock Mechanics and Rock Engineering*. Vol 32(2), 81-99.

D. Stead, E. Eberhardt and Z. Szczepanik. 1999. Acoustic emission studies on stress induced damage in sandstone. In *Proc. 9th ISRM Congress, Paris*. Eds. Vouille, G. & Berest, P. Vol 2:581-685.

L. Meyer, D. Stead and J. S. Coggan 1999. Three dimensional modelling of the effects of high horizontal stress on underground excavation stability. In *Proc. 9th ISRM Cong, Paris*. Eds. Vouille, G. & Berest, P., Vol 1:411-416.

B. Benko and D. Stead 1999. Analysis of two landslide case studies using numerical modelling. *Proc. 13th Vancouver Geotechnical Society Symposium. Slope Stability and Landslides*, p19-29 Vancouver

L. Meyer, J. S. Coggan and D. Stead 1999. Three dimensional non linear modelling of underground coal mine excavations in "Rock Mechanics for Industry". *Proc. US Rock Mechanics Symposium. Vail 99. Colorado*. Vol 1:147-152.

J.S. Coggan, D. Stead and J. Eyre. 1998. Evaluation of techniques for quarry slope stability assessment. *Trans. Inst. Min & Metall. Sect. A*. Vol 107, pB 139-147.

D. Stead, Z. Szczepanik and W. Gaskin 1998. Acoustic Characterisation of Potash. *Proc. 4th Conference on the Mechanical Behavior of Salt. IV*. *Trans Tech. Publications* p32-45.

E. Eberhardt, D. Stead, B. Stimpson and R. Rea. 1998. Determination of Crack initiation and propagation in brittle rock. *Canadian Geotechnical Journal*. V.35, No. 2, p222-233.

E. Eberhardt, D. Stead, E.Z. Lajtai and B. Stimpson. 1998 The Effect of Neighbouring Cracks on Elliptical Crack Initiation and Propagation in Uniaxial and Triaxial Stress Fields. *Journal of Engineering Fracture Mechanics*.

A. Alloway, J. Eyre, Merrett and D. Stead, 1998. Use of GPS in landslide monitoring. *Proc. 8th IAEG Congress, Vancouver, Canada, September 1998*. 8pp.

R.K. Shail, J.S. Coggan, and D. Stead. 1998. Coastal landsliding in Cornwall (United Kingdom): mechanisms, modelling and implications for coast zone management. *Proc. 8th IAEG Congress, Vancouver, Canada, September 1998*. 8pp.

E. Eberhardt and D. Stead. 1998. Numerical Analysis of slope instability in thinly bedded weak rock. *Proc 8th IAEG Congress, Vancouver, Canada, September 1998*.

D. Stead and B. Benko. 1998. The influence of underground workings on slope instability mechanisms. *Proc. 8th IAEG Congress, Vancouver, Canada, September 1998*, 8pp.

E. Eberhardt, D. Stead, B. Stimpson, and R. Read. 1997. Changes in Acoustic Event Properties with Progressive Fracture Damage. *Int. Journal Rock Mech. & Min. Sci.* 34; Nos. 3-4.

D. Stead and E. Eberhardt. 1997. Developments in the analysis of footwall slopes in surface coal mines. *Engineering Geology*. Vol. 46 No. 1 p41-61. Elsevier.

B. Benko, E. Eberhardt, D. Stead and K. Hebil. 1997. Numerical Analysis of Toppling Failures at the Luscar Coal Mine. *Proc. 2nd CIM Workshop on Soft Rock, Saskatoon*.

E. Eberhardt, D. Stead, M.J. Reeves and C. Connors. 1997. Design of Tabular Excavations in Foliated Rock: An integrated Numerical Modelling Approach. *Journal of Geotechnical and Geological Engineering*. Vol. 15: 47-85.

E. Eberhardt, D. Stead, M.J. Reeves and C. Connors. 1997. Design of Tabular Excavations in Foliated Rock: An integrated Numerical Modelling Approach. *Journal of Geotechnical and Geological Engineering*. Vol. 15:47-85.

E. Eberhardt, D. Stead and Z. Szczepanik. 1998. Acoustic emission during brittle fracture in Granite. Final Report submitted to AECL.

E. Eberhardt, D. Stead and Z. Szczepanik. 1997. Acoustic Emission studies on Lac Du Bonnet Granite. Progress Report submitted to AECL.

10.6 Research/Project Funding

Contract/Grant: Operating Grant **Awarded:** 2001 **Period:** 2001 - 2005

Project Title: Kinematics, comminution and energy considerations in surface and underground rock failure

Funding: NSERC **Type:** External **Annual:** \$26,000 **Total:** \$104,000

Involvement: Principal Investigator **Collaboration:** Dr. J. Coggan and Prof. R.J. Pine, University of Exeter, UK. Dr. E. Eberhardt, ETH, Zurich, Switzerland. Prof. M. Scoble, UBC.

Contract/Grant: Research Grant **Awarded:** 2001 **Period:** 2001 - 2004

Project Title: Characterization of Landslides in Forest terrains: an Integrated Geotechnical-Geomorphological-Hydrogeological Approach. (Awarded - Deffered pending government review March 2002: \$48000 received todate)

Funding: Forest Renewal BC. **Type:** External **Annual:** \$150,983 **Total:** \$459,334

Involvement: Principal Investigator **Collaboration:** Project Team Dr. B. Ward Dr. D. Allen M. Geertsema T. Rollerson
Institution of Co-Investigator(s): SFU, MOF, and Golder Associates

Contract/Grant: Research Grant **Awarded:** 2001 **Period:** 2001 - 2002

Project Title: Numerical modelling of complex landslides

Funding: Presidents Research Grant **Type:** Internal **Annual:** \$9,450 **Total:** \$9,450

Involvement: Principal Investigator **Collaboration:** University of Exeter, UK. ETH Zurich, Switzerland.

11. Dr Derek Thorkelson, Associate Professor (Magmatism and Tectonics)

11.1 Educational Background

1992 PhD Earth Sciences, Carleton University, Ottawa

1986 MSc Geological Sciences, University of British Columbia, Vancouver

1983 BSc Geological Sciences, University of British Columbia, Vancouver

11.2 Current Research Interests

Relations between tectonic and igneous processes involving mantle, lithosphere and melt, particularly in the contexts of convergent margin environments, ridge-trench intersections, slab windows, and Precambrian rifting and orogenesis.

Current projects are located in Yukon, British Columbia, and Patagonia. Current collaborative projects involve researchers from the United States, Australia and Italy.

Keywords: Magmatism, Tectonics, Cordillera, Precambrian, Slab Windows

11.3 Graduate Teaching

Semester	Type	Course	Number	Type	Enrollment
2002-1	Teaching	Tectonics and Magmatism	EASC621	Lecture and Seminar	1
2002-1	Teaching	Geochemistry and Geochronology	EASC704	Directed Studies	3
2002-1	Teaching	Volcanology	EASC620	Lecture and Seminar	1
2000-3	Teaching	Volcanology	EASC620	Lecture and Seminar	2
1999-3	Teaching	Geochemistry	EASC703	Directed Studies	1
1999-1	Teaching	Tectonics and Magmatism	EASC621	Lecture and Seminar	1
1998-1	Teaching	Tectonics and Magmatism	EASC621	Lecture and Seminar	1
1998-3	Teaching	Volcanology	EASC620	Lecture and Seminar	3

11.4 Senior Supervisory Duties of a Thesis/Dissertation/or Major Project

Name	Degree	Project/Thesis Title	Status	Began	Completed
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Name	Degree	Project/Thesis Title	Status	Began	Completed
Wesley Groome	M.Sc.	Magmatism and metamorphism in the Leech River Complex, BC	Completed	1998-1	2000-2
Katrin Breitsprecher	M.Sc.	Eocene volcanism and tectonics, BC	Completed	1998-3	2002-1
John Laughton	M.Sc.	Precambrian volcanism and tectonics, Yukon	Active	2001-3	
Julianne Madsen	M.Sc.	Eocene plutonism, Vancouver Island, BC	Active	2002-1	

11.5 Selected Publications

Smith, A.D., and Thorkelson, D.J., 2001. Geochemical and Nd-Sr-Pb isotopic evidence on the origin and geodynamic evolution of mid-Cretaceous continental arc volcanic rocks of the Spences Bridge Group, south-central British Columbia. Geological Journal, v. 36, pp. 1-20.

Thorkelson, D.J., Mortensen, J.K., Davidson, G.J., Creaser, R.A., Perez, W. and Abbott, J.G., 2001. Early Mesoproterozoic intrusive breccias in Yukon, Canada: hydrothermal systems linking North America to Australia. *In*: Bartley, J.K. and Kah, L.C., editors. Rodinia and the Mesoproterozoic Earth-Ocean System. Precambrian Research, special volume 111, pp. 31-56.

Thorkelson, D.J., Mortensen, J.K., Davidson, G.J., Creaser, R.A., Perez, W. and Abbott, J.G., 2001. Early Proterozoic magmatism in Yukon, Canada: constraints on the evolution of northwestern Laurentia. Canadian Journal of Earth Sciences, v. 38, pp. 1479-1494.

Johnston, S.T., and Thorkelson, D.J., 2000. Continental Flood Basalts: Episodic magmatism above long-lived hotspots. Earth and Planetary Science Letters, v. 175, p. 247-256.

Thorkelson, D.J., 2000. Geology and mineral occurrences of the Slats Creek, Fairchild Lake and "Dolores Creek" areas Wernecke Mountains, Yukon (106D/16, 106C/13, 106C/14). Indian and Northern Affairs Canada, Exploration and Geological Services Division, Bulletin 10, 73 p.

Rainbird, R.H., McNicoll, V.J., Theriault, R.J., Hearn, L.M., Abbott, J.G., Long, D.G.F., and Thorkelson, D.T., 1997. Pan-continental river system draining Grenville orogen recorded by U-Pb and Sm-Nd Geochronology of Neoproterozoic quartzarenites and mudrocks, northwestern Canada. Journal of Geology, v. 105, pp. 1-17.

Johnston, S.T., and Thorkelson, D.J., 1997. Cocos-Nazca slab window beneath Central America. Earth and Planetary Science Letters, v. 146, pp. 465-474.

11.6 Research/Project Funding – Received

Contract/Grant: Research Grant **Awarded:** 1997 **Period:** 1997 - 2000
Project Title: 31-611264
Funding: NSERC **Type:** External **Total:** \$94,800
Involvement: Principal Investigator

Contract/Grant: Equipment Grant **Awarded:** 1997 **Period:** 1997 - 1998
Project Title: 31-613148
Funding: NSERC **Type:** External **Total:** \$22,000
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1996 **Period:** 1996 - 1997
Project Title: 13-871299
Funding: SFU President's Research Grant **Type:** Internal **Total:** \$12,000
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1996 **Period:** 1996 - 1997
Project Title: Lithoprobe
Funding: NSERC **Type:** External **Total:** \$22,000
Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1996 **Period:** 1996 - 1997
Project Title: in-kind to supplement to Lithoprobe grant
Funding: Canada-Yukon Geoscience Office **Type:** External **Total:** \$10,000
Involvement: Principal Investigator

Amount	Principal Investigator	Grant Title	Period
\$22,000	Thorkelson	NSERC Equipment Grant	1997-98
\$94,800	Thorkelson	NSERC Research Grant	1997-00
\$25,490	Thorkelson	Lithoprobe Research Grant	1999-01
\$8,000	Thorkelson	Yukon Geology Program, in-kind supplement to Lithoprobe grant	2000-01
\$2.634M	James K. Mortensen, U. of British Columbia.	Pacific Centre for Isotopic and Geochemical Research (Four mass spectrometers and related equipment and contracts) Canada Foundation for Innovation: \$527000. Stuart Blusson Fund: \$1053000. BC Knowledge Development Fund: \$1053000.	2000-01
\$12,000	Thorkelson	Yukon Geology Program, in-kind supplement to Lithoprobe grant	2001-02
\$110,000	Thorkelson	NSERC Research Grant	2001-05
\$15,500	Thorkelson	U.S. Geological Survey	2002-03

12. Dr Brent Ward, Assistant Professor (Quaternary and Environmental Geology)

12.1 Educational Background

1993 Ph.D. Quaternary geology, University of Alberta, Canada (Quaternary Geology of Glenlyon Map Area (105L), Yukon Territory).

1986 B.Sc. Honours Geology, University of Alberta, Canada

12.2 Current Research Interests

Studies relating to forestry operations in the Prince George Forest Region. This project will provide quantitative data on landslide frequencies and on terrain factors contributing to post-timber harvesting landslides. These data can then be used as a predictive tool in areas that are to be harvested, allowing calibration of slope stability classes for terrain stability mapping.

Resolution of the Early Wisconsinan Stratigraphy in British Columbia. This study will center on examination of long stratigraphic records in coastal caves, a technique that has proven successful in Norway. These caves provide excellent on-off signals for glaciations. When glaciers advance and cover a cave, they cause a lake to form, allowing deposition of fine grained sediments. These sediments are excellent recorders of secular changes of the earth's magnetic field. Comparison of these records with established variations allows dating of the entire sequence. When glaciers retreat and the caves are re-exposed, they are occupied by animals providing organic remains suitable for radiocarbon dating and evaluation of the paleoclimate. If the cave has developed in carbonate rocks, then dripstones (stalagmites and stalactites) may form during non-glacial conditions. These dripstones are usually amenable to U-Th dating methods, allowing resolution back to the Early Wisconsinan.

Late Quaternary history of the Chehalis Watershed: Examination of the valley fill revealed a complex sequence of glaciolacustrine sediments separated by a Late Wisconsinan till. Radiocarbon dates on wood at the base of the lower

glaciolacustrine deposits has yielded ages of 19,400 and 19,150. Preliminary analysis of plant and insect macrofossils indicates a boreal forest dominated by *Abies* and *Picea* as Fraser ice advanced into the area. Fieldwork will continue.

12.3 Graduate Teaching

Semester	Type	Course	Number	Session	Type	Hours	Enrollment
2003-1	Teaching	Quaternary Stratigraphy	EASC 703	G01.00	Directed Studies		1
2002-1	Teaching	Environmental Geoscience	EASC619	G01.00	Lecture		3
2001-3	Teaching	Intro.grad.studies	EASC600	G01.00	Seminar	0.00	13
2001-1	Teaching	Intro.grad.studies	EASC600	G01.00	Directed Studies	0.00	1
2001-1	Teaching	Environmental Geosci	EASC619	G01.00	Lecture	2.00	1
2001-1	Teaching	Environmental Geosci	EASC619	G01.01	Laboratory	3.00	1
2001-1	Teaching	ST-Earth SciencesIII	EASC703	G01.00	Directed Studies	3.00	2
2000-3	Teaching	Intro.grad.studies	EASC600		Directed Studies	0.00	4
1998-1	Teaching	St-Earth Sci. III	EASC703		Directed Studies	3.00	1
1997-3	Teaching	Environmental Geosci	EASC619		Directed Studies	2.00	1

12.4 Senior Supervisory Duties of a Thesis/Dissertation/or Major Project

Name	Degree	Project/Thesis Title	Status	Began	Completed
Al-Suwaidi, Majid	M.Sc.	Glacial stratigraphic studies in raised wave-cut caves, Vancouver Island, British Columbia	Active	2002-1	
Utting, Daniel	M.Sc.	Surficial Geology, Quaternary History, and Till Geochemistry of Walker Lake, Nunavut (NTS 56J).	Active	2001-1	
Huscroft, Crystal	M.Sc.	Late Cenozoic history of the Yukon River valley, Fort Selkirk to its confluence with the White River.	Active	2000-1	2002-3
Brian Roberts,	M.Sc.	An analysis of Landslide frequencies following helicopter logging in the Coast Mountain Range of British Columbia.	Completed	1997-3	2001-1

12.5 Selected Publications

Utting, D.J., Ward, B. C. and Little E.C., 2002: Preliminary interpretation of Quaternary glaciofluvial landforms identified during mapping of Walker Lake (NTS56J/9-16), Nunavut. Current Research 2002-C, Geological Survey of Canada.

Ward, B.C. and Rutter, N.W. 2000. Deglacial valley fill sedimentation, Pelly River, Yukon Territory, Canada. Quaternary International, 68-71, p. 309-328

Ward, B.C. and Jackson, L.E.J. 2000. Surficial geology of Glenlyon map area (105L), Yukon Territory. Geological Survey of Canada Bulletin 559, 61 p.

Kerr, D.E., Dredge, L.A., and Ward, B.C. 1998. Surficial geology, Coppermine (86O, east half), Northwest Territories. Geological Survey of Canada, Map 1910A, at 1:125,000 scale.

Dredge, L.A., Kerr, D.E., and Ward, B.C. 1998. Surficial Geology, Kikerk Lake (86P), Northwest Territories. Geological Survey of Canada, MAP 1909A, at 1:125,000 scale.

Dredge, L.A., Kerr, D.E., and Ward, B.C. 1997. Quaternary geology, Point Lake area, Northwest Territories (NTS 86H) Geological Survey of Canada, Map 1890A at 1:125,000.

Kerr, D.E., Dredge, L.A., and Ward, B.C. 1997. Quaternary geology, Napuktalik Lake (76C), Northwest Territories. Geological Survey of Canada, Map 1889A, scale 1: 125 000.

Ward, B. C., Dredge, L.A., and Kerr, D.E. 1997 Quaternary geology, Lac de Gras, Northwest Territories. Map 1870A at 1:125 000 scale.

12.6 Research/Project Funding

Contract/Grant: Research Grant **Awarded:** 2000 **Period:** 2000 - 2004

Project Title: Marine Cave Sedimentation: new method for glacial stratigraphic studies in British Columbia

Funding: NSERC **Type:** External **Annual:** 23,600 **Total:** 94,400

Involvement: Principal Investigator

Contract/Grant: Field Support **Awarded:** 2001 **Period:** 2001 - 2001

Project Title: Surficial Geology and Quaternary History of Walker Lake (NTS 56J) M.Sc. thesis by Dan Utting

Funding: Canada-Nunavut geoscience Office - Committee Bay Project **Type:** External **Annual:** 40,500 **Total:** 40,500

Involvement: Principal Investigator **Collaboration:** Funding was provided via Edward Little to support Dan Utting for summer fieldwork. Salary for Dan, 20 hours of helicopter time, air fare from Iqaluit to Baker Lake, charter flight to field, food and lodging for 60 days in the field, and geochemical and heavy mineral analysis of samples.

Institution of Co-Investigator(s): Edward Little - Canada-Nunavut Geoscience Office

Contract/Grant: Field Support **Awarded:** 2001 **Period:** 2001 - 2001

Project Title: Surficial Geology and Quaternary History of Walker Lake (NTS 56J) M.Sc. thesis by Dan Utting

Funding: Northern Studies Training Programme **Type:** External **Annual:** 2,397.22 **Total:** 2,397.22

Involvement: Joint Investigator **Collaboration:** This grant was to support Dan Utting in the field and paid for his plane fare to Iqaluit and shipping samples to SFU.

Contract/Grant: Field Support **Awarded:** 2000 **Period:** 2000 - 2000

Project Title: Late Cenozoic history of the Yukon River valley, Fort Selkirk to its confluence with the White River

Funding: Geological Survey of Canada- Terrain Sciences Division **Type:** External **Annual:** 10,000 **Total:** 10,000

Involvement: Principal Investigator **Collaboration:** Funding was provided via Lionel Jackson to support Crystal Huscroft for summer fieldwork. Support was in the form of a salary for Crystal, transportation to and from the field, accomodation and food while in the field, and some sample analysis.

Institution of Co-Investigator(s): Dr. Lionel Jackson - Geological Survey of Canada

Contract/Grant: Field Support **Awarded:** 2000 **Period:** 2000 - 2000

Project Title: Late Cenozoic history of the Yukon River valley, Fort Selkirk to its confluence with the White River - M.Sc. thesis by Crystal Huscroft

Funding: Northern Studies Training Programme **Type:** External **Annual:** 2522.25 **Total:** 2522.25

Involvement: Joint Investigator **Collaboration:** This grant was to support Crystal Huscroft in the field and provided transportation along the Yukon River, some food and accommodation.

Institution of Co-Investigator(s): Crystal Huscroft - M.Sc. Student SFU

Contract/Grant: Research Grant **Awarded:** 1998 **Period:** 1998 - 1999

Project Title: Stratigraphical Studies of the Cordilleran Ice Sheet

Funding: President's Research Grant **Type:** Internal **Total:** \$10,000

Involvement: Principal Investigator

Contract/Grant: Research Grant **Awarded:** 1996 **Period:** 1996 - 1997

Project Title: Landslide inventory and terrain attribute study in the Prince George forest region.

Funding: Forest Renewal B.C. **Type:** External **Annual:** \$75,000 **Total:** \$75,000

Involvement: Principal Investigator **Collaboration:** Terry Rollerson

Institution of Co-Investigator(s): Vancouver Forest Region, Ministry of Forests (presently - Golder resources)