

SIMON FRASER UNIVERSITY  
Department of Earth Sciences

**3-Year Report and Plan  
July, 2006**

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**1. SYNOPSIS**

The Department of Earth Sciences is now an established academic unit in the Faculty of Science. It offers education in both traditional and environmental earth sciences. It originated as a Program in 1995 with the hire of four new faculty and the cross-appointment of two faculty from Geography. In September, 1999, the number of faculty FTE had grown to 10 and the Program was granted Departmental status.

Since the release of the previous three-year report and plan (December, 2003), the Department has grown and matured. Our faculty are well-funded, with active research programs. Presently, we have *sixteen faculty*: one Emeritus Professor, four Professors, five Associate Professors, four Assistant Professors, one Senior Lecturer and one Lecturer. In addition, we have one Limited Term Lecturer, thirteen Adjunct Faculty and two postdoctoral fellows. Interviews for an Assistant Professor in Petroleum Geology were held earlier this year, and negotiations with our preferred candidate are underway. Two of our Professors and one of our Assistant Professors are *endowed chairs* who provide additional measures of direction and leadership. Two of our Associate Professors are currently being considered for promotion. Over the next three years we expect to see several tenure and promotion applications, and continued development of our teaching and research programs.

Research activities in Earth Sciences align well with University priorities. All of our research programs are intrinsically *environmental* in nature, and examine Earth conditions and processes in the past and present; many are directly relevant to socially important topics such as climate change and resource exploitation. Many of our activities are *interdisciplinary* and are done in collaboration with geographers, biologists, climatologists. Our programs are also

becoming increasingly *international* in scope, with research links to researchers in many countries.

Earth Sciences would like to grow by adding three faculty over the next three years. If our program expands at SFU Surrey, a new Lecturer at that campus will become essential. For the Burnaby campus, the addition of a tenure-track *mineralogist* or *petrologist*, and then a *laboratory instructor*, are regarded as the most important new positions to fill.

Effective and relevant undergraduate and graduate education has remained a touchstone for the Department. A new *PhD program* in Earth Sciences opened in the fall of 2006, adding to the MSc program that began in 1996. Over the past three years, we have made numerous changes to our undergraduate program, and will soon be allowing our undergraduate students to enter into one of *three academic streams*, pending Senate approval later in 2006. Most of our undergraduate students acquire the academic qualifications to become registered as Professional Geoscientists in the Province of British Columbia and many other jurisdictions. Our students, both undergraduate and graduate, have abundant *employment opportunities* – with no down-turn in sight – mainly in the minerals, petroleum, environmental and engineering industries, in both the private and public sectors. *Enrollment* continues to grow and there is a strong sense of optimism among our students regarding career placement and advancement.

The Department moved most of its activities to the *TASC 1 building* in September, 2005. The relocation has had several beneficial effects, the most important of which are that faculty now have sufficient space to carry out research; laboratory teaching facilities for our current needs are now adequate; and faculty and staff are now located in one area on campus. However, concerns regarding *space* continue, particularly with reference to growth and contiguity. Research space for the incoming petroleum geologist, for example, is located in another building. Furthermore, we retain teaching and research space in the Communications, Chemistry and Physics areas of the Shrum classroom and science buildings, and in that sense the Department remains *incompletely united*.

In March, 2004, the Department underwent its first *five-year external review*. The review was submitted in April, 2004. In September, 2004, SCUP considered the external review, and input from the Dean of Science and the Department, and made recommendations in four main areas: space, the undergraduate program, the graduate program, and administration. These recommendations and the departmental reaction to them are described in section 2.4.

Technical and secretarial support will remain adequate for the next three years, except for some faculty who use Linux or Unix operating systems, which require specialized computing support which is unavailable in our Department. An arrangement of cost-sharing for such support, perhaps through the Faculty of Science, is suggested.

On April 1, 2006, the role of Department Chair changed hands from Diana Allen (September 1, 2003 – March 31, 2006) to Derek Thorkelson (Acting Chair and Chair-elect from April 1, 2006 – August 31, 2006; then Chair until August, 2011).

## 2. THE LAST 3 YEARS and CURRENT STATUS

### 2.1 DEPARTMENT GROWTH

Faculty: In 2002-3, the Department grew from a faculty complement of 12.5 (FTE) to 16 FTE's in 2006-7 (Table 1). The increase by 3.5 FTE's came through the return of Ted Hickin in 2005 to the Department of Geography (loss of 0.5 FTE), and the hiring of four new faculty: Glyn Williams-Jones (volcanologist, 2003-4), Dan Gibson (structural geologist, 2004-5), Gwenn Flowers (glaciologist, 2004-5), Dirk Kirste (environmental geochemist, 2006-7) and the new petroleum geologist (expected to start in January, 2007). The petroleum geology position was previously held by Brian Coffey who resigned in 2005 to return to the United States to work as a consultant but has stayed on as an Adjunct Professor.

	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
Number of FTE Faculty	6	9	10	12	13	12.5
Number of Endowed Chairs	1	1	2	2	2	2
Number of staff	1	2	3	3	3	4
Undergraduate student headcount	550	593	498	648	646	546
Undergraduate student FTEs	51.87	58.6	48.03	58.4	59.5	52.2
Number of EASC majors	32	51	42	51	45	36
Number of EASC minors	24	18	16	12	12	13
Undergraduate completions (majors)	1	5	5	14	10	8
Undergraduate completions (minors)	9	6	5	5	3	3
Certificates awarded						2
Post Doctoral Fellows	0	0	0	0	2	2
Doctoral Students (by Special Arrangements)	0	0	1	1	1	3
Graduate student headcount	4	8	14	15	25	28
Graduate student FTEs	4.0	8.0	12.7	15.0	23.0	25.7
Graduate degree (MSc) completions	0	1	1	5	4	6
<b>Graduate degree (PhD) completions</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>

	2003/04	2004/05	2005/06	2006/07*
Number of FTE Faculty	14.5	<b>15.5</b>	<b>15.5</b>	<b>16</b>
Number of Endowed Chairs	2	<b>3</b>	<b>3</b>	<b>3</b>
Number of staff	4	<b>4</b>	<b>5</b>	<b>5</b>
Undergraduate student headcount	610	<b>624</b>	<b>653</b>	<b>700</b>
Undergraduate student FTEs	58.3	<b>61.6</b>	<b>62.2</b>	<b>65</b>
Number of EASC majors	43	<b>38</b>	<b>38</b>	<b>50</b>
Number of EASC minors	11	<b>11</b>	<b>8</b>	<b>9</b>
Undergraduate completions (majors)	6	<b>7</b>	9	<b>18</b>
Undergraduate completions (minors)	4	<b>4</b>	2	<b>3</b>
Certificates awarded	0	<b>0</b>	3	1
Post Doctoral Fellows	3	<b>3</b>	<b>3</b>	<b>2</b>
Doctoral Students (by Special Arrangements)	3	<b>3</b>	<b>0</b>	<b>0</b>
Graduate student headcount	31	<b>29</b>	<b>41</b>	<b>41</b>
Graduate student FTEs	28.5	<b>24.8</b>		
Graduate degree (MSc) completions	15	<b>5</b>	<b>7</b>	<b>12</b>
<b>Graduate degree (PhD) completions</b>	<b>N/A</b>	<b>1</b>	<b>1</b>	<b>1</b>

\* Partially projected

Table 1: Indicators of program growth in the Department of Earth Sciences, 1997-2007

Diana Allen resigned from the position of Chair in March, 2006, effective March 31, 2006. Earlier that month, Derek Thorkelson had been elected to replace Dr. Allen as Chair on September 1, 2006. On the recommendation of the Dean, Dr. Thorkelson agreed to fill the vacancy by accepting the role of Acting Chair until September 1, 2006, after which his term

as Chair will commence. The shift in responsibilities from Dr. Allen to Dr. Thorkelson has been smooth, and Dr. Allen has provided advice and support to Dr. Thorkelson over the past four months to ease the transition.

The Department has thirteen Adjunct Professors, eight of which joined the Department in the past three years: Dr. Paul Whitfield of Environment Canada (2003); Dr. Duane Froese of the University of Alberta (2004); Dr. Kerrie Bann of the University of Alberta (2005); Dr. Kirstie Simpson of the Geological Survey of Canada (2005); Dr. Maurice Colpron of the Yukon Geological Survey (2005); Brian Coffey, consultant 2006, formerly SFU faculty; and Peter Bobrowsky of the Geological Survey of Canada (2006). Dr. John Moore, consultant, was renewed in 2003, and Dr. Laurent Godin of Queen's University (formerly SFU faculty) was renewed in 2006. Our adjuncts are active in various ways, including organization of field projects, co-supervision of graduate students, and sessional teaching of undergraduate courses.

In 2005, the number of staff grew from 4 to 5 (Table 1) with the addition of a new technical position, Senior Technologist. Matt Plotnikoff vacated his former position as Departmental Resource Specialist to become the Senior Technologist; Rodney Arnold was hired to fill the vacancy left by Mr. Plotnikoff. The Department is well-served by Mr. Arnold and Mr. Plotnikoff. They worked tirelessly in the Department's move into TASC 1 and continue to provide excellent service in many areas, including logistical, teaching and computer support. Our administrative and secretarial staff remain at three and continue to provide effective departmental support. Tarja Vaisanen continues in her role as Departmental Administrator, and Wendy Bourke continues as Chair's Secretary. Nedra Lodewyke is presently recovering from the long-term effects of an automobile accident and in her absence her responsibilities as Departmental and Graduate Program Secretary are being ably filled by Glenda Pauls.

## 2.2 FACULTY ACTIVITY 2003-2006

Faculty are engaged in vigorous research programs in both traditional and environmental areas of Earth Sciences. In 2003, prior to the Department's first five-year review, faculty defined three broad areas of interest: environmental geology, which includes geological engineering; sedimentology and stratigraphy; and tectonics and continental evolution. Much of the research has been directed towards better understanding earth-surface processes, or the character and evolution of the lithosphere, particularly in the North American Cordillera. Collaboration with other faculty members has generally been modest, as faculty have tended to pursue their own research interests and generate their own funding. The main collaborators with Earth Sciences faculty are positioned in other universities, government geological surveys, and industry. Funding has come from a variety of sources. All research faculty have NSERC grants and most have obtained additional support from federal or provincial geological surveys or other granting agencies. Faculty profiles are provided in Appendix 1.

Three endowed chairs add strength to the departmental research program. John Clague is a Tier-1 Canada Research Chair (CRC) who specializes in natural hazards and surficial geology. His energy and dedication led to the opening of the Centre for Natural Hazard Research (CNHR) in 2005. Doug Stead is our Forest Renewal BC (FRBC) Chair who combines rock mechanics and computer modeling to geological engineering studies of mines and unstable mountainsides. He developed a Certificate of Forest Geoscience as an academic option in Earth Sciences. Dr. Stead's original (2000) title was FRBC Chair in

Terrain Analysis and Forest Geoscience, but due to changing needs his title was changed in 2005 to FRBC Chair in Resource Geoscience and Geotechnics. Gwenn Flowers is a Tier-2 CRC chair who studies glaciology and hydrology with applications to climate change. Additional information on the FRBC and CNHR activities are provided below.

### 2.2.1 Report on The Centre for Natural Hazard Research (CNHR)

The Centre for Natural Hazard Research (CNHR) was established 2005 as a SFU Schedule A Centre. Led by CRC Chair John Clague, CNHR promotes teaching and research in the field of hazardous Earth processes and natural disasters. It fosters a program of inter- and multi-disciplinary natural hazard research involving geologists, geomorphologists, remote sensing and geographic information system (GIS) specialists, geophysicists, biologists, and social geographers. A key element of CNHR is public policy research on how to effectively transfer results of scientific research to the people who need and can use it. The Centre supports and initiates research, publication, non-credit and credit instruction, colloquia, conferences, visiting speakers and researchers, and national and international collaborations. It organized a lecture series at SFU in 2005 and is co-sponsor, with the Meteorological Service of Canada, of an "International Workshop on Avalanche Awareness," to be held in Vancouver in the fall of 2006. John Clague is the lead applicant on a current CNHR-related Canadian Foundation for Innovation (CFI) proposal entitled, "Slopes under Stress: An Integrated Program of Research on Landslides and Snow Avalanche Hazards and Risk in Western Canada." With funds from CFI (\$1.5M), the BC Knowledge Development Fund (\$1.5M), and SFU matching (\$0.8M), funding could total \$3.8M.

### 2.2.2 Report on the Forest Renewal BC (FRBC) Chair's activity

Under the direction of Doug Stead, FRBC-sponsored activities at SFU involve a strong engineering geology and resource geotechnics research program with 4 graduating MSc students to date and currently involving 4 PhD students and 2 M.Sc's. Two post doctoral fellows have been employed as part of the research group with one currently in post. The next three years will see a continued refocusing of the activities of the chair to address a wider range of resource geotechnics issues. Current research reflects this change with significant funding from the mining and forestry sectors. The Chairs NSERC operating grant has increased and been renewed until 2010. A high degree of synergy exists between the FRBC Chair and the Centre for Natural Hazards. Dr. Stead is currently a Principal Investigator of a \$3.8M funding proposal by Dr. Clague (above) for real time monitoring of natural hazards and played a major role in the geotechnical instrumentation budgeting for this proposal. Dr Stead is also currently involved with an NSERC Strategic grant submission on Landslide analysis with UBC and Queens and a Mining NSERC CRD proposal with UBC. It is anticipated that the Chair's research in large open pit mines, underground mining and natural hazards will continue to grow over the next 3 years.

As part of the mandate of the original FRBC Chair a Certificate of Forest Geoscience has been successfully offered. This has involved the development, by the Chair, of 4 new courses. EASC 313: Introduction to Soil and Rock Engineering will from 2006-7 become a core requirement of the Environmental Earth Science stream. EASC 413 has been redeveloped and renamed from Forestry Geotechnics to Resource Geotechnics to reflect the changing focus of the chair and student demand. These courses have had good enrollments for the Earth Science department and have been well received by students. Demand still exists for the Certificate in Forest Geoscience (3 students graduating in 2006), but it has been

suggested by the Chair to the advisory panel that consideration be given to renaming/redevelopment of the Certificate to a Certificate in Resource Geoscience.

## 2.3 THE TEACHING PROGRAM

Quality teaching at the undergraduate and graduate levels is characteristic of Earth Science faculty. On student evaluations, course quality and faculty teaching ability are typically rewarded with scores of 3 to 4. Students at all levels find faculty approachable, and are comfortable within the department, and these factors have led to high levels of student satisfaction. Most of our senior undergraduate students are already using their Earth Sciences education to land seasonal employment with petroleum and mineral exploration companies, and environmental geology and engineering firms. Most of the students we graduate either gain full time employment or move on to graduate studies, here or in other universities.

### 2.3.1 Undergraduate Program

Our undergraduate program has continued to grow, with an expected FTE of 65 in 2006-7 (Table 1). The most recent change to the EASC program has been the development of course concentration streams for EASC majors. Streaming is likely to clarify for students how certain course groupings will lead to different types of careers. Streaming also aligns the EASC program with the academic qualifications listed by the Association of Professional Engineers and Geoscientists of BC (APEGBC), the professional licensing agency in this province.

By streaming, students complete a common lower division cadre of courses. In the upper division, they select the area of specialization (Geology or Environmental Geoscience) with required and elective courses that facilitate the student's passage to a B.Sc. permitting professional registration. Transcripts will indicate the course concentration that was successfully completed by the student. Implementation of the program streams will likely take place in 2007-2008. Delays at the Faculty of Science Undergraduate Curriculum Committee level (that were ultimately unanimously approved), and at SCUS has resulted in the EASC streams not appearing in the upcoming calendar.

The EASC program has also been modified to accommodate the new writing, quantitative and breadth (WQB) initiatives at SFU. At the first year level, additional breadth science courses have been designed (EASC 104, 107, 108). EASC 101 and EASC 106 have also been designated science breadth, and EASC 103 has been designated science breadth as well as a writing intensive course. The latter, however, is not part of the EASC majors program. EASC 303 and EASC 310 have been granted W status and numerous EASC courses carry Q designations. Required courses in the Geology and Environmental Geoscience streams accord the students a number of WQB options.

Additional courses continue to come online in the EASC program, reflecting the expertise of new faculty members. These promise to provide students with a thorough coverage of Earth Science disciplines. Given the enrollments at the undergraduate level, however, there is a danger of low registration numbers in elective courses if care is not taken in the number and frequency of course offerings, and will likely prove to be a continuing challenge to effectively predict.

Continued disagreements surrounding issues of overlap and perceived areas of purview with the Department of Geography are anticipated. These concerns are particularly likely to be the case in the broad area of Environmental Geoscience. Geography has effectively blocked (at the SCUS level after receiving Faculty of Science support) the Earth Sciences initiative to offer a “Geology and the Environment” course (EASC 105) at Surrey as well as the main Burnaby campus. Continued expansion of Earth Sciences into this area will likely continue to be met with resistance.

The Department of Earth Sciences is aware of the problems in the Environmental Science Program, as highlighted in its recent (2006) external review document. The Department of Earth Sciences has yet to develop a collective opinion of what role, if any, our unit should play in stabilizing the Environmental Science Program beyond providing relevant courses and serving on the steering committee.

The emerging Surrey Campus represents an excellent opportunity for Earth Sciences to contribute to undergraduate education. Unfortunately, despite our repeatedly expressed interest in becoming an integral part of the Surrey Science program, no EASC course is required in either the TechOne or Science Year One programs. Currently, we only offer EASC 104 (Geohazards – Earth in Turmoil) at Surrey. We are limited in our offerings by the fact that there continues to be no laboratory space on campus for the offering of courses with dedicated labs. With expansion to the complement of EASC first-year courses, we could offer EASC 106 (Earth Through Time), EASC 107 (Economic Geological Resources), and the newly approved EASC 108 (Exploring the Solar System), though at present, the organizers at Surrey feel that the student body would be most receptive to Geohazards. None of these first-year science breadth courses are part of our major program, and there will be little incentive for potential EASC majors or minors to come out of the Surrey Campus in order to pursue Earth Sciences at the Burnaby Campus. Similarly, the lack of any requirement to take EASC courses at Surrey will likely preclude the development of a specialized EASC program in Surrey. This is exacerbated by 1) the lack of laboratory space for course offerings, and 2) by the limited (and generally undesirable) scheduling times for EASC courses, so as not to overlap the required courses in the Science Year One program. We are unlikely to make a significant impact on science at the Surrey Campus if Earth Science continues to be left out of Science Year One.

### 2.3.2 Graduate Program

The Department has been accredited to award MSc degrees in Earth Sciences since 1996 and PhD degrees since fall, 2005. The addition of a PhD degree to our program offerings has enabled us to take on a greater number of PhD students and alleviated the need for interested students to register under Special Arrangements. The current enrollment of graduate students is 39, comprising 26 MSc and 13 PhD candidates (Table 1). These numbers reflect a modest, but steady increase in enrollments for graduate students over the last 10 years. Graduate course offerings have been increased by adding EASC 624 (Geology of the Canadian Cordillera), 625 (Issues in Canadian Cordillera Geology and Tectonics), and 627 (Carbonate Depositional Systems). Many of our graduate students take courses at the University of British Columbia under an inter-university agreement. The recurring problem of finding lab and office space for graduate students has been temporarily alleviated by our move to the TASC 1 building which includes a small amount of designated graduate student offices.

## 2.4 REACTIONS TO 2004 SCUP RECOMMENDATIONS

The Senate Committee on University Priorities (SCUP) made several recommendations following the 5-year external review of Earth Sciences in 2004. Below, these are listed in abbreviated form along with the corresponding action taken by the Department or other units in the University.

<b>1. Space</b>	
1.1	SCUP recognized the issue of space as paramount to the advancement of Earth Sciences. Our move to TASC 1 has allowed us to become more united, and to develop our undergraduate program more effectively, particularly in laboratory courses. All faculty now have individual laboratories and our administrative offices now have a reasonable amount of space. However, there is no room to grow and we remain spread across three buildings: the Shrum Science Centre (Chemistry and Physics wings); the Shrum Classroom building (Communications area); and TASC 1. Where future hires are to be located is uncertain. In this regard, the recommendations from SCUP have been partially met but the issue of departmental continuity and provisions for growth remain as unresolved problems.
<b>2. Undergraduate Program</b>	
2.1	Production of a comprehensive departmental handbook for undergraduate students. The handbook is nearly ready to be released but because of the many changes to the curriculum, particularly the implementation of streaming (on Senate agenda), the final version will not be ready until late in the fall semester. In the meantime, we are taking steps to ensure that our current and incoming students are informed of the pending changes and advised accordingly.
2.2	Increase in technical support. The Dean of Science funded a new technical position and we now have the support of a Senior Technologist as well as a Departmental Resource Specialist. We do not have ready access to support for Unix or Linux computing systems, and some of our faculty would like to see this added to our support capabilities, either in-house or through arrangements at the Faculty level.
2.3	SCUP recognized the need for other departments to list EASC courses as required courses. Such changes have not occurred. This lack of action concerns us because of the reality that few students who enter first-year science at SFU intend to pursue a degree in Earth Sciences (the same is true at UBC and many universities, and is the result of how our discipline is taught – or ignored – in high school). Instead, enrollments in Earth Sciences are largely the outcome of students becoming interested in our program only after taking EASC 101; for this reason, adherence to this SCUP recommendation – to effectively boost enrollments in EASC 101 – is so important to our unit. The failure of an EASC course to be included in the main Surrey Science program is an unfortunate development, and is a cause of distress for members of our department, including our former Departmental Chair, the Undergraduate Curriculum Committee Chair, and our Departmental Assistant, all of whom worked hard to cooperate with the designers of the Surrey curriculum. The absence of a favourable outcome, so far, at SFU Surrey is yet another example of the uphill battle that Earth Sciences continues to climb in its bid to become a fully functional member of the Faculty of Science and the University.
<b>3. Graduate Program</b>	
3.1	Production of a graduate handbook. This handbook has been developed and is in circulation.



3.2	SCUP recommended the development of a core of graduate courses that are distinct from senior undergraduate offerings. We have taken steps, with the development of three additional graduate courses to gradually comply with this requirement. We anticipate that with the influx of more PhD students our graduate offerings will become increasingly designed solely for graduate students, and will have little overlap with our undergraduate program.
3.3	SCUP recommended expansion of the graduate program. Our graduate student numbers are gradually climbing, and our graduate program will become an increasingly prominent aspect of Earth Sciences.
<b>4. Administration</b>	
4.1	SCUP recommended revision of the departmental constitution in consultation with the Dean. The Dean has spoken to the former and current (acting) Chair on this topic, and we are aware of his concerns. The main issue is that our rules and procedures may be too restrictive on topics such as the formula for committee memberships and management of the budget. The former Chair initiated revisions to the constitution via consultation with faculty at department meetings in 2005. This process will continue over the next several months and by the spring of 2007 we will have formally considered modifying our constitution to make it less rigid.
4.2	The Department was encouraged to undertake a Strategic Planning process to improve departmental ambience and communication. To date, this process has not occurred but it will remain as a departmental priority and will be discussed in the fall of 2006. In the opinion of the current Acting Chair (and Chair-elect), rifts within the Department as communicated to upper management of the university have been exaggerated and belie the truth that the department has functioned remarkably well for a rapidly growing unit – one that has been under stress from a lack of space and a challenging mandate to provide strength in both traditional and environmental geology. Nevertheless, steps will be taken to ensure that the Department operates as a united, functional unit in which all faculty are afforded respect and the opportunity to prosper.

### 3. THE NEXT THREE YEARS

#### 3.1 TEACHING

The Department is poised to enjoy a productive and exciting next three years. Our *undergraduate* major program will be functioning with a three-stream system (Geology, Environmental Geoscience, and Open streams), and we anticipate that our graduates will be more prepared to seek specific types of jobs or subsequent studies than under the previous system. The university requirement for more breadth in student course selections is likely to generate significant enrollment in not only EASC 101, our main first-year course, but also in our other first year courses, EASC 103-108. In this regard, Earth Sciences will be able to provide a significant degree of curriculum “service” for students in other departments and faculties. By 2010 we expect to double the number of students taking our first-year courses, from about 330 (2005-2006) to 660. We also anticipate that the number of graduating majors in our program will also double, from 9 per year in 2005-6 to 18 in 2006-7 (constrained projection) to 24 in 2009-10. Similarly, we anticipate a jump in our minors from 2 in 2005-6, to 3 in 2006-7, and 8 in 2009-10.

The role of Earth Sciences at *SFU Surrey* is uncertain, but we are hopeful that one or more of our courses will be moved into the TechOne or Science Year One programs, and that the spirit of an integrative science program in Surrey becomes more fully adopted. With plans for a new science building at the Surrey campus taking shape, our faculty are optimistic that our

presence in Surrey will expand to provide students with a sound and interesting appreciation for Earth history, resources and processes, and an understanding of how these aspects are relevant to other sciences, human health and safety, and the stewardship of the planet.

The EASC *graduate program* will also expand in the next three years, although at a more gradual rate. Increased enrollments will come mainly as a result of new research programs generated by recent and future faculty hires. There are no foreseen major obstacles to continued growth of our graduate program but space for graduate students will begin to be a concern when our graduate enrollment exceeds 50-60 students, a range we will likely reach within the next three to five years. Some SFU Earth Sciences faculty have expressed a desire to more formally link graduate studies in our department with that of Earth and Ocean Sciences at UBC. This idea was also expressed by the authors of the 2004 five-year review and it remains to be more thoroughly explored. In any case, many graduate students will continue to take one or two courses at UBC to augment the offerings available at SFU.

### 3.2 FACULTY HIRING

The Department is hopeful that it can hire three additional faculty members over the next three years (Table 2). A survey of Earth Sciences faculty in June, 2006, indicates that a new tenure-track faculty member is first on the priority list, followed closely by a laboratory instructor. Considering new tenure-track faculty, the departmental preference is for a mineralogist or petrologist, followed by a paleontologist. The former is desired because of the increasing number of students who are interested in pursuing careers in the minerals industry. The latter is desired because of the importance of paleontology to a variety of aspects of earth sciences, including earth evolution, environmental geology and climate change. A lab instructor (we do not yet have one) is considered important because we anticipate an increase in our student enrollments, and the ability of our faculty, staff and TA's to curate the laboratory materials, and manage specimen-rich exercises, is becoming increasingly difficult. Separate from these appointments is the possible addition of a Lecturer to teach our hopefully expanding role in Surrey.

Possible Year of Appointment	Category	Detail
2007-8	Tenure-track faculty	Mineralogist or Petrologist
2008-9	Laboratory Instructor	
2008-9	Lecturer	For SFU Surrey

*Table 2: Suggested hiring in Earth Sciences*

### 3.3 SPACE

Space remains an important consideration for Earth Sciences. One issue is that we are spread across three buildings. Significantly, one of our three main teaching labs (C9015) is located in the Chemistry area of the Shrum Science Centre, a several minute walk from our home base on the ground floor of TASC 1. We understand that the Department of Chemistry would like this laboratory returned to them, and we would like to accommodate that request, but Earth Sciences will need to have a large and properly outfitted laboratory in replacement. The best replacement space would be the large room in the northwest corner of the ground floor of TASC 1 (room 7000). It is virtually empty and "uninhabited," but since it is under the control of Applied Sciences, it has remained unavailable to our department. Another space issue is that we have no additional space to assign to new faculty that we might wish to hire. The successful candidate for our most recent position, a petroleum geologist, will have a

research laboratory in the Communications area of the Shrum Classroom Building. Although his lab is only a short walk from TASC 1, the possibility of obtaining more space in that area seems remote. Nevertheless, the desire and general departmental plan is to gain more space closer to our present headquarters in TASC 1 so that we can continue to grow in, more or less, one locality on campus.

### 3.4 ALIGNMENT WITH UNIVERSITY PRIORITIES

Many departmental initiatives are underway to align Departmental activities with University priorities for (a) ramping up overall research productivity, (b) giving special attention to the environment, (c) increasing interdisciplinary research, and (d) increasing international activities. Regarding (a) and (b), all EASC tenure-track faculty are vigorously pursuing research programs, and most of these are relevant to the geological environment as it was in the past, how it is in the present, or how it may be in the future. Below are some of the international and interdisciplinary efforts that are underway and will help to shape the departmental research profile for the next three years.

#### 3.4.1 Interdisciplinary Research

Dirk Kirste is collaborating with researchers in the Cooperative Research Centre for Greenhouse Gas Technologies (CO<sub>2</sub>CRC) in Australia. He is working on developing geochemical models for the geosequestration of CO<sub>2</sub> and on monitoring strategies for a CO<sub>2</sub> storage pilot site. He is also undertaking research on the geochemistry and biogeochemistry of acid hypersaline lakes to study interactions between microorganisms and minerals, especially the impact of microorganisms on mineral weathering and crystal growth, biomineralization, and geochemical cycling and as analogues for conditions on Mars with Dr. Jill Banfield of UC Berkeley, the National Aeronautics and Space Administration (NASA) and Dr. Sue Welch of the Australian National University. In addition, he is collaborating with researchers in the Cooperative Research Centre for Landscape Environments and Mineral Exploration (CRC LEME) Australia on developing methodologies for the application of hydrogeochemistry in mineral exploration.

Dr. Clague conducts research with biologists, geographers, and archaeologists at SFU and seven other universities in Canada and abroad. He is an Associate Member of the SFU Department of Archaeology. Clague is a principal member of the Western Canada Cryosphere Network, a group of geographers, hydrologists, and geophysicists funded by the Canadian Foundation for Climate and Atmospheric Sciences to conduct an interdisciplinary research program on present and past glaciers in British Columbia.

Dr Stead is currently working closely with the Department of Mining at UBC including collaboration on a multi-national block caving research through a 4 year research proposal funded by Diavik Diamond Mining (Rio Tinto.)

Dr. Allen's research is highly interdisciplinary. She is the project leader for a Canadian Water Network (NCE) research grant entitled "Groundwater Recharge in Okanagan Basin: Bridging the Gap Between Science and Policy". The research group includes physical scientists, spanning a number of disciplines, and social scientists. She has also conducted research of relevance to fisheries biology, particularly in regard to low flows in streams and the potential impacts of climate change.

In addition to traditional geochemical research, Dr Marshall's research also includes paleoclimatological studies utilizing stable and radiogenic isotope analyses of cave deposits, with application to current climate change. Drs. Allen and Flowers are also pursuing collaborative research on physical and chemical responses to climate change. Dr. Ward works cooperatively with researchers in geography, forestry, and archeology on a variety of topics including studies related to the peopling of North America.

### 3.4.2 International Activities

Dr. Clague was the co-leader of a recent project funded by the Swedish government (STINT) to exchange of faculty and graduate students between Swedish universities and SFU. In 2006, Clague established a research program in New Zealand in cooperation with the Institute of Geological and Nuclear Sciences (GNS Science). As President of INQUA (International Union for Quaternary Research), Clague interacts with scientists in 45 countries around the world.

Dr. Calvert has recently completed work with US and Canadian collaborators on the 8-year SHIPS project (Seismic Hazards Investigation in Puget Sound). He is currently a participant in the Canada-US NEPTUNE project that is about to begin installation of a cabled seafloor observatory in the northeastern Pacific Ocean. Dr. Calvert is also currently working with US (Stanford, Washington University in St Louis, University of Hawaii) and Japanese (Japan Marine Science and Technology Centre) collaborators on the NSF-funded MARGINS study of the Mariana volcanic arc.

Dirk Kirste is collaborating with researchers in Australia at the Cooperative Research Centre for Greenhouse Gas Technologies, Australian National University and the Cooperative Research Centre for Landscape Environments and Mineral Exploration.

Dr Stead is involved in underground mining related research in the US, (Bingham Canyon and Resolution mines), South Africa (Palabora mine) and Australia (North Parke mine). He is will also over the next 4 years be collaborating with mining faculty from the University of Chile including supervision of a Chilean graduate student at SFU. He has also hosted visits to SFU by Dr Stead is a visiting professor at the University of Exeter, UK and has collaborated in mining and landslide research publications with several UK scientists. During the last four years extensive research has been undertaken with ETH Zurich, Switzerland on mountain rockslides – this international research on rock slides is being extended to Italy (Universities of Milan and Bologna) in 2007.

Dr. Allen's research is highly interdisciplinary. She is the project leader for a Canadian Water Network (NCE) research grant entitled "Groundwater Recharge in Okanagan Basin: Bridging the Gap Between Science and Policy". The research group includes physical scientists, spanning a number of disciplines, and social scientists. She has also conducted research of relevance to fisheries biology, particularly in regard to low flows in streams and the potential impacts of climate change.

Dr. Williams-Jones is involved with volcanological studies in Europe, the Americas and South East Asia. Dr. Thorkelson is working on Precambrian plate reconstructions with the International Geological Correlation Programme (a United Nations organization), and on the Patagonian slab window with researchers from the University of Florida. Dr. Marshall will be pursuing a program of gemstone analysis and its geological context in China. Dr. Stead is

organizing the first Canada-US Rock Mechanics Symposium. Dr. Flowers will be continuing her international work on glaciers. Dr. Gibson will continue to pursue advanced techniques of geochronology at the University of Massachusetts and the NERC Isotope Geoscience Laboratory in the UK. Dr. Ward will be working cooperatively with the Berkeley Geochronology Center in California. Dr. Roberts is engaged in collaborative research projects in Germany and France.

Ratified by the Department on July 27, 2006
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Derek Thorkelson  
Acting Chair and Chair-elect  
July 27, 2006

#### 4. APPENDIX 1: FACULTY PROFILES

**Diana Allen** is a groundwater hydrologist whose research program focuses on various aspects of climate change and the potential impacts of climate change on groundwater recharge, groundwater levels, and groundwater-surface water interactions, particularly low flows in streams. Dr. Allen's research group has developed methodologies for linking GCM climate predictions to groundwater models to simulate predicted groundwater level variations under scenarios of climate change. Future research will explore climate impacts on recharge in forested uplands, with possible focus on slope stability, and potential impacts of climate change on groundwater resources for international sites (India, Mongolia and Ghana). Dr. Allen is funded by NSERC, the Climate Change Action Fund, the Canadian Water Network, Environment Canada, the BC Ministry of Environment, and Whatcom County (WA)

**Andy Calvert** is a seismologist who is studying the nature and occurrence of non-volcanic tremors in the Cascadia subduction zone, and their relationship to the local tectonic regime. In addition, over the next three years Dr Calvert will be working with various collaborators on the integration of geophysical and geological data to understand better the tectonic evolution and internal architecture of the Nechako basin in the interior of BC. His funding is derived from a variety of sources including NSERC, US geological Survey, and Geoscience BC.

**Kevin Cameron** is a Lecturer. Courses taught include Physical Geology, Historical Geology, Economic Geological Resources, Introduction to Mineralogy, Introduction to Petrology, Introduction to Geochemistry, Field Geology I, Directed Readings and has assisted teaching Field Geology II. Kevin is an undergrad student advisor and as such is kept extremely busy assisting students in planning their course selections and schedules for their program. He is currently Chair of the departmental Outreach committee. Although Kevin is not actively engaged in conducting research, he is keenly interested in projects of various researchers and grad students within the Earth Sciences department – in particular studies of igneous rocks, ore deposits, geochemistry, physical volcanology, among others. In addition, he is assisting a MSc student from the Archaeology department at UNBC in identifying lithologies of stone implements used by prehistoric native peoples in an area of northern BC in an attempt to source these various materials.

**John Clague** is Director of SFU's Centre for Natural Hazard Research. He conducts research on hazardous geophysical processes and associated risk, including earthquakes, tsunamis, landslides, floods, and climate change, mainly in British Columbia, Alaska, and Yukon. Clague is also continuing his long-standing research on Quaternary history and environments of western North America. He plans to expand the geographic scope of his research to New Zealand and the Andes in 2007. Funding for Clague's research comes from NSERC (Discovery Grant), CFCAS, and CRC.

**Robbie Dunlop** is a Senior Lecturer in the Earth Sciences Department. Courses that she teaches include Physical Geology, Historical Geology, The Earth Through Time, Teaching Earth and Space Science Kindergarten to Grade Seven, The Rise and Fall of the Dinosaurs, Paleontology, Field Geology 1 and Field Geology 2. She has been involved with the BC Colleges and Universities Earth Sciences Articulation Committee since 1995 and is the past and current Chair of this committee. During her term as Chair she will be coordinating the completion of a province-wide Transfer Innovations Project and will be developing a website for the use of the Earth Sciences and Geography Articulation Committees. During the next three years, Robbie will be attending both the BC and the Alberta Paleontology Societies' Annual Symposia as well as seminars involving Writing Intensive Learning that are held at Simon Fraser University. Robbie has been involved with the Writing Intensive Learning Office since its inception several years ago, as a pilot project member. She will continue to develop new courses involving the Writing to Learn method. Robbie's main interests include public outreach and she will continue to offer free workshops to schools as well as being involved with EdGeo workshops and fieldtrips that are designed to teach Earth Sciences to school teachers.

**Gwenn Flowers** is a glaciologist with interests in glacier and ice-sheet dynamics, the hydrology of glacierized systems and the relationship of these systems to climate. More broadly, I am interested in the glaciological elements of watershed hydrology, natural hazards and climate change. My interests have led me to explore the subglacial hydrology and dynamics of alpine glaciers, glacier surge dynamics, outburst floods from ice-dammed lakes, ice-cap climate sensitivity and the hydraulics of ancient ice sheets. Field-based and modelling techniques complement one another in most of these pursuits. In the field, geophysical, meteorological and hydrological measurements are used to evaluate the geometry, mass balance and flow structure of a glacier. These data are the foundation for the development of theoretical and numerical models used to better understand the physics of various glaciohydraulic processes. My current focus, geographically speaking, is on glaciers in the Yukon and Iceland.

**Dan Gibson** is a structural geologist who is interested in mid- to lower crustal processes associated with mountain building events (orogenesis). His research is both lab and field intensive with a focus on structural, metamorphic, and geochronologic analyses. Current projects are located in the Canadian Cordillera within southeastern British Columbia and Yukon Territory. In the next three years Gibson intends to expand his program to include the ancient Archean and Proterozoic rocks of northern Saskatchewan. He will also continue pursuing cutting-edge geochronologic techniques that utilize chemical mapping via Electron Microprobe and in-situ U-Th-Pb analyses of radiogenic minerals. Gibson collaborates with a number of agencies that include the Yukon Survey, the Geological Survey of Canada, UBC, Carleton University, the University of Massachusetts, and NIGL in the UK. Dr. Gibson's research is primarily funded by NSERC.

**Dirk Kirste** is an aqueous geochemist whose research is primarily directed towards understanding the processes controlling the composition of groundwater and surface water. His research involves both lab and field based work investigating the chemical and isotopic composition of water, minerals and gases. By recognizing and using variations in the chemistry he is able to address problems in our environment, in characterizing and predicting the effects of climate change and in resource exploration and evaluation. He applies a broad range of techniques including: developing field based sampling and monitoring strategies; applying different analytical methods; designing lab based experimental procedures; and, developing and applying computer simulations. Some of his current topics of research include acid sulfate systems, water quality, the geosequestration of CO<sub>2</sub> and mineral exploration using hydrogeochemistry.

**Dan Marshall** is a geochemist concentrating on fluid-rock interaction and isotopic studies applied to a wide variety of research initiatives including metamorphic petrology, ore deposits, tectonics and paleoclimatic research. Over the next three years his work will continue on metamorphic core complexes in BC, ruby and emerald deposits worldwide, base metal deposit studies in the cordillera, and speleotherm paleoclimatic studies on Vancouver Island. He will continue to work collaboratively with colleagues at UBC, the French and Chinese governments and a number of universities across Canada. His funding is mainly derived from corporations and from NSERC with minor grants from the provincial and federal governments.

**Peter Mustard** applies aspects of clastic sedimentology, stratigraphy, structural geology, isotope geochemistry and field geologic relationships to reconstructing the tectonic and dispositional evolution of sedimentary basins and their association to tectonic models for the evolution of the Canadian Cordillera. His near term future research involves studies of Mesozoic sedimentary basins of the Canadian Cordillera. These studies are multi-disciplinary and generally include several co-researchers from federal and provincial government agencies and other research institutes. They include geologic mapping, traditional sedimentology and stratigraphy studies, isotope geochemistry applied to provenance and tectonic history of basins, and general structural and tectonic evolution studies of these sedimentary basins. Funding continues to be provided from NSERC plus several grants from the B.C. Ministry of Energy Mines and Petroleum Resources and a recently awarded major 3 year research grant from Geoscience B.C. Considerable in-kind support has been received for recent field studies from the Geological Survey of Canada.

**Michael Roberts** (emeritus). Mike Roberts' research interests focus on the links between geomorphology and environments of deposition and include ongoing work dealing with the evolution of the Fraser River Delta (BC), the coarse- clastic facies of cusped forelands (Dungeness, UK; Darss. Germany) and fan deltas in fjords (BC). He is engaged in collaborative research projects with colleagues at the University of Regensburg and the University of Lyon (II).

**Doug Stead** is the current FRBC Chair in Resource Geoscience and Geotechnics. His 5 year contract was renewed in September 2005 until September 2010. During the last 5 years Dr. Stead has acted as Graduate Program Chair (1 year), Department Chair (1 year) and President of the Canadian Geoscience Council (2 years). He is currently Associate Editor of the Canadian Geotechnical Journal and on the editorial boards of Engineering Geology, the Geological Society of London Special Publications and the International Journal of Surface Mining. Dr. Stead has been on the organizing committee of four international conferences and is currently co-chair of the organizing committee of the 1<sup>st</sup> Canada-US Rock Mechanics Symposium to be held in Vancouver in May 2007. During the first 5 years as FRBC Chair the Endowed Chair was transferred from Forest Renewal BC to Simon Fraser University with responsibility passing to the Ministry of Advanced Education. In response to a changing BC and Canada resource sector and student demand Dr Stead successfully renegotiated the change in name of the FRBC Chair from Terrain Analysis and Forest Geoscience to the FRBC Chair in Resource Geoscience and Geotechnics.

**Derek Thorkelson** is a petrologist and tectonicist who blends field-based and theoretical investigations with geochemistry, geochronology, and plate tectonic modeling in studies of igneous, sedimentary and metamorphic complexes. He is a leader in the study of spreading ridge-subduction zone interaction and is a principal researcher of the Precambrian history of Yukon. Over the next three years he will continue these investigations to (a) develop a global model of mantle contamination from spreading ridge subduction, and (b) determine the position of ancestral North America in global continental reconstructions. He works collaboratively with members of the British Columbian, Yukon, and Canadian geological surveys, and academic colleagues at a variety of institutions, including the University of British Columbia, the University of Alberta, and the University of Tasmania. Dr. Thorkelson is funded by NSERC, the US Geological Survey, the Yukon Geological Survey, and the Geological Survey of Canada.

**Brent Ward** has been studying glaciation and paleoenvironments in the Canadian Cordillera and forestry related landslides. Over the next three years he intends to continue his studies in the Canadian Cordillera and utilize some of the techniques he learned while on a recent sabbatical: terrestrial cosmogenic nuclides to date glaciations, U-Th-He to date uplift and landscape evolution, and U-Th to date pedogenic calcium carbonate formation. He will also become involved in marine geology work on the West Coast. Outside of colleagues at SFU he will be working cooperatively with BC Ministry of Forests, Berkeley Geochronology Center, Dalhousie University, Douglas College, Geological Survey of Canada, GEOTOP, Parks Canada, and Yukon Geological Survey. His funding is mainly from NSERC with additional funding from the Yukon Geological Survey, Yukon Heritage Branch and the Geological Survey of Canada. Funding for landslide research is from the British Columbia Ministry of Forests.

**Glyn Williams-Jones** has been investigating the processes controlling persistently active volcanoes by integrating the study of geophysical signatures with geochemical and remote sensing data to understand precursory signals to volcanic activity and the mechanisms that trigger eruptions. Over the next three years he intends to build on exciting new developments in continuous geophysical and geochemical monitoring to investigate active volcanoes in the Galapagos (Ecuador), Indonesia and Central America working cooperatively with groups from the University of Hawaii, Western Washington University, The Open University (UK) and McGill University. His funding is mainly from NSERC although he is currently co-investigator on two multi-year NSF grants.