Graduate Studies in Geology and Environmental Geoscience

at the

University of Toronto

2009-2010

05/2010

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Department of Geology
Earth Sciences Centre
University of Toronto
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http://www.geology.utoronto.ca

05/2010

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THE DEPARTMENT OF GEOLOGY

Geology has been taught at the University of Toronto since 1847, at which time the institution was known as King's College. The appointment of E.J. Chapman as Professor of Mineralogy and Geology in October of 1853 marks the actual birth of the Department as a distinct entity. This rich legacy and the continuing accomplishments of faculty, students and alumni, affirm an enduring commitment to the highest standards of teaching, research, and service.

GRADUATE DEGREE PROGRAMS

Students may register in full- or part-time programs in the Department of Geology. The Ph.D. program allows full-time enrolment only, whereas full- or part-time status are allowed for the M.Sc and M.A.Sc. Part-time students and those in the all-course M.Sc. program or enrolled as special students, are not eligible for financial support. General information on admission, registration, and the rules under which the Department of Geology operates are contained in the School of Graduate Studies (SGS) handbook (www.sgs.utoronto.ca). **Note that for students enrolled prior to September, 2006, the degree requirements are different than more recently admitted students; please see the Table in the section on Course Work.**

Doctor of Philosophy (Ph.D.)

The main requirement for the completion of the Ph.D. degree is to carry out a major program of original research, with the completion and satisfactory defense of a thesis.

Candidates are normally admitted to the Ph.D. program after completion of a M.Sc. or M.A.Sc. degree; however, outstanding candidates who have completed a B.Sc. or B.A.Sc. may apply for direct admission into the Ph.D. program.

A Ph.D. student is normally required to complete the graduate seminar course, one of the six breadth courses and an additional half-course, for a total of 1.5 FCE. The additional half-course may be taken in departments other than Geology with the approval of the student's advisory committee. A reduction in the number of required courses may be granted for students who have previously undertaken graduate studies in the appropriate fields. Recommendations must be made by a student's advisory committee for consideration and approval by the Department's Graduate Affairs Committee. Students who begin the Ph.D. program directly from the Department's research-based M.Sc. are required to take one of the six breadth courses and an additional half-course. In all cases, the student's supervisory committee reserves the right to assign additional courses if they feel that the student is deficient in a subject area essential to the research.

Doctoral candidates are guaranteed funding for four years, or five years for students admitted directly from a B.Sc. or B.A.Sc., and must complete all requirements for the degree within six years from first enrolment. In exceptional circumstances, a candidate who has failed to complete degree requirements within this period may be considered for up to two one-year extensions with approval of the Graduate Affairs committee and the School of Graduate Studies.

Master of Science (M.Sc.)

Students in the all coursework option are normally required to complete the graduate seminar (GLG 1101H), the all-course research project (GLG 3608H), one of the six breadth courses and 3.5 other courses for a total of 5.0 graduate full-course equivalents (FCE). Students in the doctoral-stream option are normally required to complete the graduate seminar (GLG 1101H), the research project (GLG 3603Y), research presentation (GLG 3601Y), one of the six breadth courses, and 1.0 FCE of elective courses, for a total of 4.0 FCE. To encourage breadth, the Department will permit students to substitute electives with equivalent non-geology courses. Students may proceed on a part-time basis.

Candidates are admitted into the program with the equivalent of a four-year B.Sc. or B.A.Sc. Students are required by the university to complete all degree requirements within five years, but full-time students are expected to complete the program within one year. Guaranteed funding is strictly limited to one year for doctoral stream M.Sc. students.

Master of Applied Science (M.A.Sc.)

This is a Master's program for students wanting to write a formal thesis; it is intended for focussed research not leading to doctoral study. Students are admitted to the M.A.Sc. degree program after completion of a B.Sc. or B.A.Sc. (or an equivalent degree in engineering). Students are normally required to prepare a research thesis, and complete the graduate seminar (GLG 1101H), one of the six breadth courses, and 1.0 FCE of elective courses, for a total of 2.0 FCE. Minimum full-time residence is one academic session. Guaranteed funding may extend to two years, and degree requirements must be completed within three years.

Environmental Studies Collaborative Program

The purpose of the collaborative program is to develop interdisciplinary studies through cooperation with the Centre for Environment at U. of T. Doctoral or master's students apply to and register in the Geology Department, and then register with the Centre for Environment Student Graduate Student Advisor. For additional details, the student is referred to Graduate Studies at the Centre for Environment.

Geology and Physics Collaborative Program

The graduate units of Geology and Physics participate in the Collaborative M.Sc. and Ph.D. Programs in Geology and Physics. These programs foster graduate education in those areas of study that overlap traditional departmental boundaries. Candidates who wish to enrol in the Collaborative Program must apply to and be admitted to both the Collaborative Program and a graduate degree program in Geology or Physics. For further details, the student is referred to the entry on the School of Graduate Studies Calendar.

APPLICATION PROCEDURES

It is recommended that students contact potential research supervisors to discuss graduate research opportunities before making a formal application to the Department. Students wishing to apply to the Department of Geology can obtain an online application package form from the department website. In addition to the documents sent to SGS, the applicant is also required to submit with their application package to the Geology Department a one page statement describing general career objectives, including a preference for program of study with a research component (i.e., doctoral stream), or involving coursework alone. It is not necessary for doctoral stream students to propose a specific research project, which is determined normally after admission in consultation with individual graduate supervisors. Applicants will be informed of outstanding requirements for the completion of their application.

Minimum academic requirements for admission are:

(a) Master's programs

(i) A four-year B.Sc. or B.A.Sc., or its equivalent from a recognized university.
(ii) High academic standing, equivalent to a B or higher (equivalent to a 3.0 on a 4 point scale) at the University of Toronto, normally demonstrated by the average grade in the final year.

(b) Ph.D. program

i. An appropriate M.Sc. degree, or its equivalent from a recognized university. Direct entry from a bachelor's degree is also possible for applicants providing evidence of exceptional scholastic achievement and skill at research.
ii. High academic standing equivalent to a University of Toronto B+ or higher (equivalent to a 3.3 on a 4 point scale) in previous degrees.

If your primary language is not English and you graduated from a non-Canadian university where the language of instruction and examination was not English, then you must demonstrate your facility in English by completing either the TOEFL, IELTS, MELAB or COPE tests, achieving the minimum scores prescribed by the School of Graduate Studies. The minimum TOEFL score required for admission into the Department of Geology is 580 with a TWE of 5; or an overall score of 93 (with 22 on the Writing/Speaking) on the Internet-based test. The proficiency requirement should be met at the time you submit your application and must be made before registration is allowed. You are not required to complete an English-language facility test if you are a Canadian citizen who studied at a Canadian university where the language of instruction is French. If you are an international applicant whose primary language is not English, you may not be required to complete an English-language facility test if you have completed a program of study at a university where the language of instruction and examination has largely been in English. Please consult the Graduate Affairs Officer in the Department of Geology to determine if the test will be necessary. An official statement from your institution will be required, confirming the use of English as the language of instruction and examination.

An admissions committee, chaired by the Associate Chair for Graduate Affairs, evaluates applications for admission to graduate studies in the Department of Geology. To be considered for guaranteed funding and scholarship assistance, ALL applications, both domestic and international, must be complete (i.e., transcripts, letters of reference, English proficiency exam scores, etc.) and received in the Department Geology by **1 February, 2010.**

The prompt acceptance or refusal of an admission offer is requested as a courtesy to respect the aspirations of other applicants, given the limited number of positions available in any year.

GRADUATE STUDENT LIFE

ASSOCIATION OF GEOLOGY GRADUATE STUDENTS (AGGS)

All Geology graduate students are members of AGGS. The main objectives of the organization are stimulation of geological inquiry, representation of the interests of the students at Departmental and higher levels within the university, and organization of various social events within the Department. AGGS elect an executive each spring for the following academic year.

AGGS is responsible for carrying on the long tradition of RockFest on Friday afternoons during term time. Each RockFest consists of two 20-minute talks, presented by students or faculty, and informal discussion is encouraged. Refreshments are served at

minimal cost. AGGS also assists in the maintenance of the graduate and faculty lounge on the third floor of the Geology Department. Parties, sporting events and field trips are organized at various times, and there is a dinner-dance in the spring, to which all faculty and graduate students are invited.

COST OF LIVING

The following is a rough estimate of the minimum amount of Canadian currency a single student should have available for living expenses in excess of tuition for their first year in Toronto:

Accommodation	$ 8,500.00
Meals	$ 3,800.00
Clothing	$ 650.00
Books and Stationary	$ 750.00
Local Transportation	$ 1,100.00
Total	$14,800.00

This amount of money should provide an adequate standard of living. The cost estimate assumes accommodation in a university residence or in a room off campus, preparing your own meals, and the monthly purchase of a subway (TTC) pass. Although it is possible to live economically, many students take advantage of opportunities outside the University community to enjoy the diversity of Toronto, and to participate more fully in the life of the city. Of course, this will involve additional costs.

FINANCIAL SUPPORT AND FEES

Applicants are advised to consult the School of Graduates Studies web page (www.sgs.utoronto.ca) for the most up-to-date information on financial support and fees.

Guaranteed Funding

The status of the University of Toronto as a leading research university depends critically on recruiting outstanding graduate students and enabling them to complete their studies in a timely fashion. Realization of this goal requires that students have adequate financial resources so they can focus on their studies. For this reason, guaranteed financial support packages are extended to eligible doctoral-stream students for up to five years of study. Eligible doctoral-stream students and corresponding periods of guaranteed funding, subject to satisfactory progress, are defined in the Department of Geology as:

(a) One year for students admitted to the research (i.e., doctoral stream) option of the M.Sc. program, or the M.A.Sc. program.

(b) Four years for students admitted to the Ph.D. program after completion of a M.Sc. or M.A.Sc.
(c) Four years for M.Sc. students that transfer to the Ph.D. program after completing one year of funded study according with (a) above (total of five years of guaranteed funding)
(d) Five years for students admitted directly to the Ph.D. program after completion of a B.Sc. or B.A.Sc.

The guaranteed funding package for each student consists minimally of a base stipend plus an amount to cover tuition and fees. While subject to change, for the 2009-2010 fiscal academic year (September 1 to August 31) in Geology these are:

(a) M.Sc. and Ph.D. $24,440, consisting of a $17,000 base stipend plus $7,440 tuition and fees.
(b) International (visa) students are provided with additional funding to cover the full costs of the fee differential (including UHIP) for foreign nationals.
(c) Holders of major external scholarships (e.g., NSERC, OGS; see below) receive additional support above the guaranteed minimums defined above. This supplemental funding is limited to coincide with the period of the award, which in many instances is no more than a year. As such, students must apply regularly for scholarships during their tenure in the Department.

The guaranteed funding package of each student is derived typically from a number of sources including external awards such as NSERC or OGS scholarships, research assistantships (RA), teaching assistantships (TA), and other University of Toronto funding.

Teaching Assistantships (non-scholarship students)

All students that do not hold a major internal or external scholarship (i.e., value greater than $10,000) are required to apply for a TA, which in some cases may necessarily be found in cognate departments outside of Geology. Because a TA is considered as an integral part of the guaranteed funding packages extended to non-scholarship students, failure to apply for and obtain a TA position can jeopardize guaranteed funding. A student who refuses a TA assignment that is offered as part of the funding package relinquishes the corresponding funding that the TA provides.

Teaching assistants at the university are members of the Canadian Union of Public Employees, which is the official bargaining unit for working conditions, grievances and rates of pay. The number of hours to be worked as a TA is viewed notionally in the Department of Geology to be about 150-160 hours per academic year.

Research Assistantships

These are funded directly from supervisor research accounts. In addition to University-mandated enrolment quotas, the availability of RA funds is one of the main factors that places limits on the number of students that can be admitted to the Department. The value of a RA is set at the level required, together with the TA, plus any scholarship the student has been awarded, to bring eligible students' income over the 12 month academic year up to the guaranteed minimum.

University of Toronto Fellowships

There are no eligibility restrictions for University of Toronto Fellowships (UTF) based on citizenship or status in Canada, nor are students required to apply for UTF awards. Current graduate students are required to be progressing in a satisfactory and timely fashion, as documented in the minutes of their advisory committee meetings. The amount of an individual UTF award is variable depending largely on the total UTF funding available to the Department. Awards for each academic year are recommended to the School of Graduate Studies by the Associate Chair for Graduate Studies, subject to budgetary constraints, as follows:

(a) Eligible non-scholarship students are awarded an amount equivalent to their tuition plus fees
(b) Eligible non-scholarship visa students are awarded an amount equivalent to the fee differential for foreign nationals
(c) Students holding major scholarships receive a UTF supplement
(d) Eligible Canadian and visa students are awarded amounts from the remaining UTF funds available to the Department.

An explicit condition for holding a UTF award is that students must be registered degree candidates in attendance for a minimum of 14 weeks in any session in which they hold an award. Except for absences needed for research purposes, and approved by supervisors, students must reside within reasonable proximity of the Department. Students not in full-time attendance will be required to repay the award.

SCHOLARSHIPS, FELLOWSHIPS, AND OTHER FINANCIAL SUPPORT

In addition to being financially beneficial in the short-term, scholarships provide enduring long-term documentation of meritorious academic and research performance. As mentioned above, students are expected to apply for scholarships on a regular basis. Several prominent scholarships are described below. Note that the School of Graduate Studies maintains a far more comprehensive list of scholarships, fellowships, loans, and bursaries. It is essential that students ensure that their applications for NSERC and OGS/ OGSST scholarships are complete by the deadlines below. Since both applications

require university transcripts and letters of recommendation, neither of which can be easily obtained at the last minute, it is advisable to start assembling application materials early in the Fall term. ***Applications will not be considered if received after the internal deadline.***

Natural Sciences and Engineering Research Council (NSERC) of Canada

NSERC offers graduate scholarships to Canadian citizens and permanent residents in a Canada-wide competition. The scholarships are awarded on the basis of high academic achievement and evidence of skill at research. These are highly competitive and prestigious awards. Applications may be made through the student's home institution prior to admission to the University of Toronto. Eligible students in the Department are required to apply and submit applications in the Fall. Additional information and application forms are available from the NSERC web site (www.nserc.ca). The award values are $17,300 to $21,000 (PGSA and B, respectively) and $17,500 to $35,000 (CGS for M.Sc. and Ph.D, respectively) and are for two to three academic years. The departmental application deadline is **9 October**.

Ontario Graduate Scholarships (OGS)

The Government of Ontario offers these graduate scholarships for tenure at Ontario universities. These scholarships are intended primarily for domestic students; however, a small number are available to visa students. The value is $15,000 and is for one academic year. Application forms are obtained on-line at: http://osap.gov.on.ca/eng/not_secure/OGS.htm) . The departmental application deadline is **26 October**.

Ontario Graduate Scholarships in Science and Technology (OGSST)

The Geology Department has seven OGSST awards available each year. The award is designed to encourage excellence in graduate studies in science and technology. The value is $15,000 and is for one academic year at a time. Applicants who apply for OGS awards are automatically considered for an OGSST.

Connaught Scholarships

This prestigious award from the University of Toronto is made to meritorious doctoral stream visa students in research-oriented degree programs. The scholarship covers tuition + fees and the department provides a $16,300 stipend for living expenses. The award is normally renewed yearly while the student is part of the funded cohort.

Keevil/Finlay Scholarships

For meritorious doctoral stream students from developing countries, the Department of Geology has several scholarships valued at $17,000 plus tuition and fees. The scholarships are offered at the time of admission, so students do not have to apply for them separately. The scholarships are awarded for a term of study corresponding to the time that the student is in the funded cohort and continuation past this may be awarded upon review of the student's progress.

Full-Time Studies, Residency and Employment

Students registered as full-time students in Geology must be engaged in their studies on a full-time basis, as required by government regulations for full-time graduate studies. Full-time students are not permitted to undertake paid employment totaling more than an average of 10 hours per week in any session (i.e., the fall, winter, or summer terms of the academic year), either outside or within the University, including work as a teaching assistant. In addition, full-time students are not permitted to be away from the University for extended periods of time, or to participate in a program offered by another university without the explicit permission of the Graduate Affairs committee. Any student who undertakes excessive paid employment, or who is absent from the University without receiving approval, will be considered to have lost good standing. This can jeopardize guaranteed funding eligibility, and in extreme cases may result in a recommendation to the School of Graduate Studies to terminate a student's registration and candidacy.

Graduate Funding Payment Schedule

The funding package for graduate students often comprises funds from a number of sources. Each of these funding sources can be on a different payment schedule. The following table lists the payment schedule for several typical graduate student funding sources.

Funding Source	**# of Payments**	**Payment Interval**
UTF	1 or 2	Sept and Jan
NSERC/OGS/OGSST	2 or 3	Sept, Jan, May
RA	12	monthly
TA	8	monthly

PROCEDURES FOR THE COMPLETION OF GRADUATE DEGREES

The following sections outline the steps students will need to follow in order to complete their graduate degree. These notes should be read as guidelines for students and their faculty advisors to follow. Formal requirements for completion are indicated. Variations in the steps, for example in the sequence or timing of advisory committee meetings and examinations, are at the discretion of the Department. Students or their supervisors must consult with the Associate Chair for Graduate Affairs before proposing any modifications.

FIRST STEPS FOR NEW STUDENTS

Upon arrival in the Department, new students must register with the Graduate Affairs Officer and meet with their supervisor as soon as possible to discuss the research program. In the case of M.A.Sc., and Ph.D. students, the student and supervisor must also agree on the formation of an advisory committee who will follow the student's progress during their stay in the Department. This committee should consist of the supervisor plus two other members of the graduate faculty, chosen to provide some expertise in areas of specialization that the student may encounter during the course of the research. **Note that a supervisory committee is not required for a non-thesis M.Sc.**

Supervisors are responsible for arranging advisory committee meetings within the first month of enrolment. The committee should:

(a) Discuss the research program.
(b) Decide on course work. Note that all new students, regardless of degree program, are required to take the Graduate Seminar course (GLG1101H; see description below). Doctoral stream M.Sc. students must also enroll in GLG3601Y (Research Project) and GLG3603Y (Research Presentation; see descriptions below). If the committee feels that the student is deficient in a subject area essential to their research, they may also assign additional courses beyond the required minimum.
(c) Prepare formal minutes of the meeting, which are to be signed by those attending and a copy filed with the Graduate Affairs Officer.

COURSE WORK

The School of Graduate Studies stipulates that normally "A graduate course is understood to require at least two hours per week of lectures or seminars, plus such laboratory hours as may be required" over an academic session. In addition, satisfactory

performance in a degree program requires the completion of all courses taken for graduate credit with a grade of at least a B-.

If a student does not complete a graduate course according to the required standard, fails a course (i.e., receives a grade report of 'FZ', 'FL', or 'NCR' in a course), or does not complete a course (i.e., receives a non-grade report of 'INC'), then the Graduate Affairs committee may recommend to the School of Graduate Studies to terminate the registration and candidacy of the student. If the student is permitted to continue, he or she must repeat the failed or incomplete course, or an alternative course (recommended by the supervisor and Graduate Affairs committee for approval by the School of Graduate Studies), and obtain a grade of at least a B-.

For students entering degree programs **prior** to September, 2006, the following research and course requirements apply:

Degree Program	*Thesis Required*	*Required Courses*	*Optional Courses*	*Total FCE*
M.Sc. (course work option)	No	GLG1101H	4.5 FCE	5
M.Sc. (doctoral stream option)	No	GLG1101H GLG3601Y GLG3603Y	2.5FCE	5
M.A.Sc.	Yes	GLG1101H	1.5 FCE	2
Ph.D.	Yes	GLG1101H	1.0 FCE	1.5

For students entering degree programs in September, 2006 and later, the following research and course requirements apply:

Degree Program	*Thesis Required*	*Required Courses*	*Optional Courses*	*Total FCE*
M.Sc. (course work option)	No	GLG1101H GLG3608H One GLG breadth course*	3.5 FCE	5
M.Sc. (doctoral stream option)	No	GLG1101H GLG3601Y GLG3603Y One GLG breadth course*	1.0FCE	4
M.A.Sc.	Yes	GLG1101H One GLG breadth course*	1.0 FCE	2
Ph.D. (from M.Sc. doctoral stream option)	Yes	One GLG breadth course*	0.5 FCE	1
Ph.D. (from external M.Sc. or direct entry)	Yes	GLG1101H One GLG breadth course*	0.5 FCE	1.5

*The Geology breadth courses are (refer to the Department website for descriptions and scheduling scheduling information):

GLG2222H Tectonics and Planetary Dynamics
GLG2302H Mineral Resources
GLG2303H Earth Systems Evolution
GLG2304H Geochemistry
GLG2704H Isotope Geochemistry
GLG2708H Characterization of Geological Materials

DESCRIPTION OF REQUIRED COURSES

GLG1101H Seminars in Geology The course is designed to help the student develop their scientific presentation skills. During the term, students will be required to deliver at least two oral presentations on assigned topics, and provide critique for the presentation of other students in the course. The course is given on a pass/fail basis, and will meet weekly in the Fall term.

GLG3603Y Research Project Students must complete a research project assigned by the supervisor. During the first two weeks of the term in which the student first registers, the student and supervisor must reach an agreement on the objectives and methodology of the research project, along with an evaluation scheme. This information must be conveyed to the Associate Chair of Graduate Studies for their approval. The final product for this course is a written document of the work performed (approx. 40 pages in standard format[1]). For candidates who start their M.Sc. studies in September, the final grade for this course must be submitted to the Graduate Affairs Officer no later than the end of the third week of the following August.

GLG3601Y Research Presentation The mark for this course is based on the written report produced in **GLG3603Y** and the student's performance in an oral defense of that work. The examining committee for the oral defense will consist of the supervisor and two members of the graduate faculty selected by the supervisor. The student must provide members of the examining committee a copy of the report at least one week in advance. The oral defense will consist of a 20 minute presentation of the work, followed by questioning by members of the examining committee. Other students may attend the presentation and question period with the permission of the candidate and examining committee. The examination concludes when the committee finishes with questions. Each committee member will evaluate the student based on the quality of the written report, and the student's explanation of it, the depth and breadth of knowledge relevant to the project demonstrated during the oral examination and overall originality and creativity.

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[1] Standard format is page margins of 2.5 cm, double spaced with a minimum 12 point font. The length includes diagrams, figures, *and* any appendices

The mark for this course will be the average mark assigned by the three examiners. For candidates who start their M.Sc. studies in September, the final grade for this course must be submitted to the Graduate Affairs Officer no later than the end of the third week of the following August.

GLG3608H All-Course Research Report This is a term-length course to provide exposure to research for students in the department's all course M.Sc. program. Students are required to contact a potential research supervisor prior to the start of term to decide upon a research project. The project must involve critical analysis and interpretation of information, be it experimental, analytical or field observations, as acquired by the student, or gleaned from the literature. The final product for the course will be a 20 page (1.5 spaced, 12 point font, including figures and tables) report descibing the work accomplished, and a 20 minute oral presentation. The student will receive 80% of their mark from the research supervisor based on the report, and 20% from the faculty members attending the presentation. Prior to commencing, the student must submit a project plan, developed in consultation with the research supervisor, for approval by the Associate Chair of Graduate Studies.

SUPERVISORY COMMITTEE MEETINGS

Students enrolled in the M.A.Sc. and Ph.D. programs must meet with their advisory committee at least once a year to review and discuss progress. This annual supervisory committee meeting should occur sometime in the fall term. Advisory committees are obligated to meet more frequently if a student is having difficulty with any aspect of their stay in the Geology Department.

In a written report (maximum four pages) the student will document their research over the past year and outline future directions. This report should be distributed to members of the supervisory committee at least one week before the committee meeting. At the meeting, the student is expected to make a presentation that outlines the progress of their research over the past year and future objectives. This presentation should not be considered as a formal defense of the work by the student, but rather an update to allow for constructive discussion with the supervisory committee.

The supervisory committee is expected to provide feedback to the student, assessing progress in the program and providing advice on future work. The committee will document recommendations from the meeting, with a written report to the student and a copy filed with the Graduate Affairs Officer along with a copy of the student's written report. If they so wish, the student is welcome to respond to the committee's recommendations with a written attached response.

M.A.Sc. THESIS AND ORAL EXAMINATION

Research carried out by M.A.Sc. students results in a thesis, which is defended during an oral examination involving the thesis supervisor and members of the supervisory committee. The research should attack a significant scientific question, but need not involve extensive laboratory or field investigations. The work should be brought to a point where research potential is demonstrated and the candidate's ability to carry out independent work can be evaluated.

There are no formal page limits for M.A.Sc. theses, but students should be advised that conciseness (e.g., not more than 150 pages) normally means a clear expression of important ideas. Where the research includes large quantities of descriptive information, such data can be included in appendices at the end of the thesis. The oral examination is conducted in an identical fashion to that for the M.Sc. research project.

Minutes of the examination and notification of the result must be written up by the supervisor, circulated to all who attended the examination, and filed with the Graduate Affairs Officer.

Ph.D. THESIS PROPOSAL DEFENSE

A formal examination is required for doctoral stream students who are about to begin the research component of their degree program. This examination must be held within eight to twelve months of the first arrival of the student in the Department. The purpose of the examination is to ensure that the student candidate is qualified to advance and complete an independent research project in a timely fashion.

A written research proposal consisting of ***no more than 15 typewritten pages*** (single spaced, minimum 12 point font; including figures, references and appendices) must be ***prepared by the candidate***. This proposal should contain:

(a) A short abstract of no more than 250 words.
(b) A clear statement of the research problem, its significance and thesis objectives.
(c) A brief critical review of the directly relevant literature.
(d) An outline of the research methodology describing the measurements and observations to be made.
(e) A discussion of how the measurements and observations will address the problem identified in (b) above.
(f) A timetable of research activities through to completion (i.e., thesis defense).

The proposal document must be circulated to the examining committee at least one week before the examination. Examining committees consist of the three member supervisory committee, plus two other members of the graduate faculty chosen by the supervisor, with the approval of the Associate Chair Graduate Affairs. One of these examiners, not the supervisor, serves as a chair of the examining committee and takes the minutes of the meeting.

The thesis proposal defense begins with a 20-minute oral presentation of the research proposal by the candidate, using visual aids where necessary. Questions from the examining committee follow, and may range over all the areas of specialization touched on explicitly or implicitly by the proposed research. Other students may attend the presentation and question period with the permission of the candidate and examining committee.

Upon completion of questioning, the candidate and audience must withdraw. The student will be evaluated on:

(a) The quality of the written thesis proposal, and the candidate's defense of it.
(b) Depth and breadth of knowledge in the chosen area of study, including relevant basic science.
(c) The scientific merit and level of innovation of the research problem and approach to solving it.
(d) The likelihood of achieving success in the research in a four-year period.
(e) Originality, creativity, and ability to make critical judgments on scientific matters.

The examining committee, following appropriate discussion, vote for a pass or fail. A majority of four votes is required for pass. The conditions of a fail must be communicated immediately and clearly in writing to the candidate. Candidates who fail are required within six months to repeat the thesis proposal examination, but if they fail the second time, they must withdraw from the program.

Minutes of the thesis proposal examination and notification of the result must be written up by the chair of the examining committee, circulated to all who attended the examination, and filed with the Graduate Affairs Officer.

THESIS PREPARATION

A thesis may be prepared in one of two formats. The classic thesis consists of a final report that is complete and not in itself intended for publication. Styles and formats for such documents have evolved over the years, and the candidate should consult a recently completed thesis for guidance. There is a tendency for theses to become

excessively long. While the imposition of page limits would be inappropriate, students should be advised that conciseness (e.g., not more than 150 pages) normally means a clear expression of important ideas. Where the research includes large quantities of descriptive information, such data can be included in appendices at the end of the thesis.

An increasingly popular mode of thesis preparation is to write it up in the form of the series of papers prepared for submission to refereed journals for publication. Because of journal format requirements, a certain amount of repetition may be unavoidable; e.g., provision of sample location information or experimental protocols. The coherence of the research program may therefore not be immediately apparent, so the candidate is required to write an introductory chapter, which sets out the overall objectives, and explains how the chapters relate to each other. A final chapter providing a synthesis or summary must also be prepared that enables the candidate to discuss the overall significance of the research project and directions for further work. It is not a factor in the examination of the thesis whether or not the papers have been published or accepted for publication.

Where research is carried out as part of a team project, publications are commonly co-authored with other students and/or faculty advisers. If this is the case, the division of responsibilities in authorship must be carefully explained in the introductory chapter of the thesis. To gain the necessary credit for the doctoral degree, the candidate's intellectual contribution to the papers must be significant. Moreover, if a paper has been published before submission of the thesis, written authorization from the copyright holder (normally the journal publisher) must be obtained in order to include it in the thesis.

The thesis must be accompanied by an abstract, and may be completed with an appendix not intended for publication containing supplementary information such as maps, diagrams, and data. The School of Graduate Studies requires an electronic copy of the final accepted thesis (see below). Information about "Electronic Thesis and Dissertation", including guidelines for preparation, is posted on the School of Graduate Studies web site (www.sgs.utoronto.ca).

FINAL COMMITTEE MEETINGS Ph.D. DEGREE PROGRAMS

There are three major milestones to be passed for the completion of a Ph.D. degree. First the candidate's final committee meeting, when the advisory committee members are asked to agree the thesis is defensible. Second, the Departmental oral examination, and third, the final Senate Defense, convened by the School of Graduate Studies.

The purpose of the final committee meeting is to ensure that all members of the advisory committee have read the thesis and are prepared to accept it, at least in principle, as meeting the requirements of a Ph.D. thesis. To reach this stage the candidate should

have submitted the thesis to all advisory committee members, met with them, as necessary, to discuss problems and necessary modifications, and completed at least one round of revisions.

When the advisory committee is satisfied that the thesis is defensible and complete in all respects, the supervisor arranges with the Associate Chair for Graduate Affairs for the holding of the Departmental defense. The examining committee consists of the three-person advisory committee plus one other faculty member, the latter to act as chair of the examining committee and is responsible for recording the results of the examination.

The candidate must provide each member of the examining committee with a copy of the thesis complete in all respects (but not permanently bound) at least 2 weeks before the examination, the exact time to be negotiated with the advisory committee. In normal circumstances, the committee will have read various drafts of the thesis and should be sufficiently familiar with the content to expeditiously review the entire submitted draft in a relatively short time. The chair of the examining committee will be responsible for conducting the examination in a fair and impartial manner. The committee chair will have had the opportunity to review the main elements of the thesis but not necessarily to have read it word by word.

The conduct of the examination, including the oral presentation, the presence of guests, questions, and voting procedures are the same as for a Ph.D. thesis proposal defense (see above).

There are three possible outcomes of the departmental defense: pass, conditional pass and fail. The candidate is informed of the results of the examination immediately following the vote. A conditional pass stipulates that the candidate has moderate modifications to be made to the thesis, which should be reviewed with the supervisor (and other committee members, if deemed necessary) before the thesis is sent for external review. In the case of a conditional pass or failure, suggestions for revisions and improvements must be conveyed in the form of a written letter to the candidate as soon as possible. A copy of this letter and the minutes of the examination should be filed with the Graduate Affairs Officer. Informal discussions with the supervisor regarding the results of the examination are also likely to be valuable for the candidate.

In the event of a failure, which implies that the examination committee believes the thesis requires major and extensive revision, the candidate has the right to request that the thesis be taken to the Senate defense without Departmental approval; however, the candidate is strongly advised to retake the Departmental defense, incorporating all necessary revisions.

At the time of a successful Departmental defense, the examination committee holds a discussion regarding possible candidates for the external appraiser. The external appraiser must be from outside the university and its affiliated hospitals, have an arms-length relation with the candidate and supervisor, and most hold an academic appointment at the level of associate or full professor. If the person comes from outside the academic sector, he/she must possess the qualifications to be appointed to this rank. The external appraiser does NOT have to be a member of the committee that examines the candidate in the senate exam, although this is an option. The external appraiser's report is another piece of material to be taken into account by the senate examining committee in their decision of the outcome of their examination. Suggestions for external appraisers are submitted to the Associate Chair of Graduate Studies, who will chose one, determine their availability to submit a recommendation by the proposed exam date, and submit the choice to SGS for final approval. An "internal examiner" to serve on the examination committee should also be selected at this time. This individual must be a member of the School of Graduate Studies and possess some knowledge of the candidates field of research.

THE FINAL Ph.D. SENATE THESIS DEFENSE

Candidates are advised that, upon submission of the final version of the thesis, SGS requires six weeks to arrange for a Senate defense. Requests to shorten this time are discouraged because they place an unreasonable workload upon the external examiner and internal appraiser. A request for the setting of the Senate defense is submitted by the Associate Chair for Graduate Affairs, at the request of the supervisor, who must provide the names of all examiners and must acknowledge that the proposed timing of the examination is acceptable to all. At this time the candidate is required to submit the following: an abstract of the thesis, a brief *curriculum vitae*, and a list of publications, if any. The candidate is responsible for delivering a complete copy of the thesis to each member of the examining committee at least four weeks before the examination.

The examining committee for the Senate defense consists of four to six persons, four constituting a quorum, and includes at least one, but no more than three members of the supervisory committee. One of the other members of the examination committee may be the external appraiser. Regardless of whether the external appraiser serves on the examination committee, this individual is required to submit a written appraisal of the thesis for circulation to the candidate and examination committee two weeks prior to the examination. The appraisal is to be taken under consideration in the committee's decision on the outcome of the senate examination. Regulations and procedures for the conduct of the Senate defense are provided in the School of Graduate Studies Handbook.

Travel arrangements and expenses for the external examiner are primarily the responsibility of the supervisor. A small travel subsidy of $500 is available from the

School of Graduate Studies. Supervisors should consult with the department business officer to arrange for reimbursement.

The candidate and supervisor are reminded that the time from the final committee meeting to the Senate defense is a minimum of 10 weeks. Given the existence of deadlines for completion of degree requirements for the purpose of graduation and for the payment of additional fees, planning for the completion of a Ph.D. must begin well in advance.

RESEARCH AND LIBRARY FACILITIES

The Department of Geology occupies five floors in the south wing of the Earth Sciences Centre, which is located in the southwest corner of the St. George campus in downtown Toronto. Space in shared offices is normally allocated to all doctoral stream students. The research groups of individual faculty members carry out their work in laboratories designed and equipped to meet their specialized needs.

Departmental facilities and services available to support research activities include laser ablation ICP-MS, electron microprobe, X-ray fluorescence, neutron activation analysis, analytical scanning electron microscopy, thermal ionization mass spectrometers and X-ray diffraction as well as thin-sectioning, graphic, and computer support. The ANALEST analytical chemistry laboratory, solid state NMR (400/200 mHz) and confocal Raman microprobe are available in the Department of Chemistry, potassium-argon dating and accelerator mass spectrometry facilities are available in the Department of Physics and time of flight (ToF) SIMS is housed in the Department of Chemical Engineering.

Department computing facilities consist of connections to the University backbone for high-speed Internet access, UNIX based RISC workstations, research and teaching LANS, and access to a variety of specialized equipment including but not limited to slide scanners, slide makers, large format colour output devices, high capacity printing and specialized software.

The library system at the University of Toronto (www.library.utoronto.ca) ranks as the largest academic library in Canada, and is fourth among research universities in North America. There are over 30 integrated libraries that include college libraries, special collections, and specialized libraries covering subject areas from architecture to zoology.

The Noranda Earth Sciences Library, immediately adjacent to the Department of Geology, contains the major geoscience collections at the university. Materials include books, journals, and theses as well as government and technical reports. The staff at the

Noranda Earth Science Library provides reference services and consultation to help carryout effective search strategies for research in geology.

UNIVERSITY OF TORONTO MISSISSAUGA (UTM)

The University of Toronto Mississauga (formerly known as Erindale College) is situated in a picturesque setting along the Credit River, some 40 minutes drive west from the main St. George campus. A half-hourly shuttle bus provides a convenient link between the campuses. Erindale hosts the largest centre in Canada for the study of rock magnetism and paleomagnetism. On-campus housing is available for graduate students.

UNIVERSITY OF TORONTO SCARBOROUGH (UTSC)

Scarborough Campus of the University of Toronto has an international reputation for graduate work in glacial geology, environmental geology and the hydrogeology of urban areas. Geology at Scarborough enjoys a position within a large environmental science group providing many opportunities for interdisciplinary work such as with the biological sciences. Researchers have a close relationship with several area municipalities, which has translated into many excellent research projects involving the study of the impact of urbanization on natural environments.

ROYAL ONTARIO MUSEUM

The Royal Ontario Museum (ROM) is located on the northwest corner of the university campus. The ROM is an independent agency of the Ontario Government, but was once part of the university and still maintains a close relationship. Many of the ROM curators are cross-appointed to the university as professors to teach classes, supervise graduate students and participate in other university activities. This relationship gives students and staff of the university access to the ROM collections and facilities, and makes the ROM a major teaching and research asset of the university.