

**Graduate Studies in Earth Sciences**  
**at the**  
**University of Toronto**

Department of Earth Sciences  
Earth Sciences Centre University of Toronto  
22 Russell Street  
Toronto, Ontario M5S 2B1  
Canada

<http://www.es.utoronto.ca>

## Executive Summary

This handbook serves as a guide for potential, new, and current graduate students in the Department of Earth Sciences at the University of Toronto. Because the handbook reflects up-to-date guidelines regarding Departmental procedures including (but not limited to) degree requirements and funding, faculty are advised to review the material in their capacity as graduate student supervisors. The following table is intended to serve as a quick reference for material relevant to both students and supervisors.

The contents of this handbook are up to date as of July, 2017.

The editing of this handbook was undertaken by AGESS members Magdalena Sobol, Vasa Lukich, Neva Fowler-Gerace, Carter Grondahl, Alexandre Boivin, Jessica Arteaga, Kirsten Kennedy, and April Dalton, with special thanks to Scott Moore and Dr. Jorg Bollmann for their invaluable contributions.

<b>Degree</b>	<b>Guaranteed Funding Period</b>	<b>Required Courses</b>	<b>Electives</b>	<b>Total number of required courses (full-course equivalents)</b>	<b>Procedures for Degree Completion</b>
M.Sc. (doctoral-stream)	1 year	ESS1101H ESS3601Y ESS3603Y 1 breadth course	.5	3.5	<ul style="list-style-type: none"> <li>- Discuss research project with supervisor ASAP</li> <li>- Submit 40-page research report</li> <li>- Final oral examination</li> </ul>
M.Sc. (all-course)	N/A	ESS1101H ESS3608H 1 breadth course	3.5	5.0	<ul style="list-style-type: none"> <li>- Successful completion of all required courses</li> </ul>
M.A.Sc.	2 years	ESS1101H 1 breadth course	1.0	2.0	<ul style="list-style-type: none"> <li>- Discuss research project with supervisor ASAP (form committee for annual meetings)</li> <li>- Submit thesis</li> <li>- Thesis defense before committee</li> </ul>
Ph.D. (from doctoral stream M.Sc.)	4 years	1 breadth course	0.5	1.0	<ul style="list-style-type: none"> <li>- Discuss research project with supervisor ASAP (form committee for annual meetings)</li> <li>- Thesis proposal defense</li> <li>- Submit thesis</li> <li>- Final committee meeting</li> <li>- Thesis defense before committee</li> <li>- Senate defense before external examiners</li> </ul>
Ph.D. (from external M.Sc.)	4 years	ESS1101H 1 breadth course	0.5	1.5	
Ph.D (direct entry)	5 years	ESS1101H 1 breadth course	0.5	1.5	

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## DEPARTMENTAL CONTACTS

### Department Chair

Prof. Russ Pysklywec                      416-978-4852                      [chair@es.utoronto.ca](mailto:chair@es.utoronto.ca)

### Administrator, Graduate and Undergraduate Programs

Mr. Scott Moore                      416-978-1240                      [s.moore@utoronto.ca](mailto:s.moore@utoronto.ca)

### Associate Chair, Graduate Studies

Prof. Jorg Bollmann                      416-978-2061                      [jorg.bollmann@utoronto.ca](mailto:jorg.bollmann@utoronto.ca)

### Reception

Departmental Office                      416-978-3022                      [welcome@es.utoronto.ca](mailto:welcome@es.utoronto.ca)

# THE DEPARTMENT OF EARTH SCIENCES

Earth Sciences have been taught at the University of Toronto since 1847 when 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 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-time or part-time programs in the Department of Earth Sciences. The Ph.D. program allows full-time enrolment only, whereas full- or part-time status is allowed for the M.Sc. and the M.A.Sc. programs. Part-time students and those in the all-course M.Sc. program are not eligible for financial support. General information on admission, registration, and the rules under which the Department of Earth Sciences operates are available on the School of Graduate Studies (SGS) website ([www.sgs.utoronto.ca](http://www.sgs.utoronto.ca)).

### **Doctor of Philosophy (Ph.D.)**

Students carry out a major program of original research and perform a thesis defense. Students are normally required to complete a total of 1.5 Full Course Equivalents (FCE): the graduate seminar course (ESS1101H), one of six breadth courses, and an additional half course. A reduction in the number of required courses may be granted for students who have previously undertaken graduate studies in the appropriate field. Students who begin the PhD program directly from the department's research-based MSc are required to complete a total of 1 FCE: 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 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 four one-year extensions with approval of the Graduate Affairs, Admissions, and Awards Committee, as well as the School of Graduate Studies.

### **Master of Science (M.Sc.)**

In the *all-course* master's program, students are required to complete a total of 5.0 FCE, including the graduate seminar course (ESS1101H), the research project (ESS3608H), and one of six breadth courses; interested students are advised to contact the Associate Chair for Graduate Studies for more information about this program. The majority of students, however, pursue the *doctoral-stream* (also known as research-based) master's, which involves a one-year research project (ESS3603Y) that culminates in a research report (shorter than a formal thesis) and presentation (ESS3601Y). In addition, students must complete a total of 1.5 FCE including the graduate seminar course (ESS1101H) and one of six breadth courses. The time limit to complete all degree requirements is three years for full-time students and six years for part-time students, but students are strongly encouraged to complete the program within one year as guaranteed funding within

the Department will not extend beyond that point.

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

Students perform a two-year focused research project and write and defend a formal thesis. Students are required to complete a total of 2.0 FCE including the graduate seminar course (ESS1101H) and one of six breadth courses. In order for students to be guaranteed funding for two years, the potential supervisor must agree to this before students are accepted. Degree requirements must be completed within three years.

### ***Collaborative Programs***

The graduate unit of Earth Sciences participates in two collaborative programs: Earth Science and Physics with the Department of Physics (M.Sc., Ph.D.) and Environmental Studies with the School of Environmental Studies (M.A.Sc., M.Sc., Ph.D.). These programs foster graduate education in those areas of study that overlap traditional departmental boundaries. Students who complete the requirements of a Collaborative Program will receive a notation on their transcripts. Candidates who wish to enroll in the Collaborative Program must be admitted to both the Collaborative Program and a graduate degree program in their home department.

## GRADUATE STUDENT LIFE

### *Association of Graduate Earth Sciences Students (AGESS)*

The main objective of AGESS is to support the graduate student body and represent its interests within higher levels of the Department and the University. All Earth Sciences graduate students are members of AGESS, which is headed by an executive committee traditionally consisting of a President, Social Chair, Treasurer, and Rockfest Chair; other positions may be created should a need be recognized. AGESS elects executives each spring for the following academic year.

In addition to providing academic and personal support, AGESS also coordinates a variety of social engagements throughout the year, including field trips and a semi-formal event at the conclusion of the spring term. AGESS is responsible for organizing Rockfest, an event held on Friday afternoons during the fall and winter terms that involves two informal 15-minute presentations by students or faculty. **All graduate students are expected to give a Rockfest presentation during their tenure within the Earth Sciences Department.** In the summer months, AGESS holds a weekly BBQ on the fourth floor patio in order to raise money for events throughout the year. AGESS also assists in the maintenance of the graduate and faculty lounge on the third floor of the Department of Earth Sciences.

Any questions may be directed to [agess@es.utoronto.ca](mailto:agess@es.utoronto.ca).

### *AGESS Representatives 2017/2018*

#### **President**

Alex Boivin	<a href="mailto:alex.boivin@mail.utoronto.ca">alex.boivin@mail.utoronto.ca</a>	ES4099
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#### **Vice President**

Tanya Kizovski	<a href="mailto:t.kizovski@mail.utoronto.ca">t.kizovski@mail.utoronto.ca</a>	ES3113
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#### **Treasurer**

Tim Rodgers	<a href="mailto:tim.rodgers@mail.utoronto.ca">tim.rodgers@mail.utoronto.ca</a>	ES3122
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#### **Faculty Liaison**

Carter Grondahl	<a href="mailto:carter.grondahl@mail.utoronto.ca">carter.grondahl@mail.utoronto.ca</a>	ES4118
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#### **Undergraduate Liaison**

Yaw Adjei-Kyereme	<a href="mailto:y.adjei.kyereme@mail.utoronto.ca">y.adjei.kyereme@mail.utoronto.ca</a>	ES3113
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#### **CUPE Liaison**

Erin Seagren	<a href="mailto:e.seagren@mail.utoronto.ca">e.seagren@mail.utoronto.ca</a>	ES3126
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**AGESS Secretary**

Katie Maloney [katie.maloney@mail.utoronto.ca](mailto:katie.maloney@mail.utoronto.ca) ES3126

**AGESS Meeting Chair**

Simen Johnsen [simen.johnsen@mail.utoronto.ca](mailto:simen.johnsen@mail.utoronto.ca) ES4

**AESRC Rep**

Marissa Davies [marissa.davies@mail.utoronto.ca](mailto:marissa.davies@mail.utoronto.ca) ES2

**Rockfest Chair**

Marissa Davies [marissa.davies@mail.utoronto.ca](mailto:marissa.davies@mail.utoronto.ca) ES

**Social Chair**

Liz Phillips [elizabeth.phillips@mail.utoronto.ca](mailto:elizabeth.phillips@mail.utoronto.ca) ES

## FINANCIAL SUPPORT

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

### *Guaranteed Funding*

The position 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 graduate students. Financial support packages comprise several components: external and Departmental scholarships, teaching assistantships (TAs), contribution from the supervisor (the research assistantship, or RA), and a contribution from the University (the UTF). The balance of these components is determined for each student by the Associate Chair for Graduate Studies according to need and available funding. The funding package covers the student's tuition and fees and provides a minimum stipend (\$18,500 in 2017-18) to assist with living expenses.

Subject to satisfactory progress, the guaranteed funding periods are as follows:

**All-course M.Sc.** Some funding may be available, determined yearly by the Graduate Affairs, Admissions, and Awards Committee. Please contact the Associate Chair for Graduate Studies for more details.

**Doctoral-stream M.Sc.** One year.

**M.A.Sc.** Two years, though the second year must be entirely provided by the supervisor. Applicants must contact potential supervisors before applying to determine the potential for a second year of funding.

**Ph.D.** Four years for students admitted to the Ph.D. program after completion of a master's degree, or five years for direct-entry Ph.D. students.

The tuition and fees (covered by guaranteed funding packages) for the 2017-18 academic year (September to August) are \$8,480.14 for domestic students (Canadian citizens or permanent residents) and \$23,692.14 for international (visa) students. The total guaranteed funding package includes these tuition and fee amounts plus the guaranteed minimum stipend (\$18,500 in 2017-18).

### *Teaching Assistantships*

In general, TA hours constitute a part of the guaranteed funding package described above. All students who do not hold a major internal or external scholarship (such as those that provide the entire required funding amount) are required to apply for a TA position, which in some cases may necessarily be found in cognate departments outside the Department of Earth Sciences.

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 assignment provides.

In some cases, TA hours in addition to those required for the funding package are available (for example, summer courses, assignments in cognate departments, exam invigilation and other “emergency” assignments). TA hours above those required to make up the funding package provide extra money directly to the student. Students considering extra TA hours should consult their research supervisors to ensure that the extra hours do not jeopardize their research.

Teaching assistants in the Department of Earth Sciences are automatically members of CUPE 3902, the union representing contract academic staff at the University of Toronto since 1975. Being a member of this union has several benefits, including the Health Care Spending Account (HCSA), Fellowship Defense Fund, Childcare Financial Assistant Funds, and the Fund for International Student Health Expenses. All new employees must attend a training program of at least three hours in duration that must be included as part of the paid TA contract hours. Each year, AGESS elects a CUPE Liaison; you are encouraged to contact him/her if you have any concerns with regards to TA positions and CUPE. Please visit the CUPE website to learn more ([www.cupe3902.org](http://www.cupe3902.org)).

### ***Research Assistantships***

These funds are sourced directly from supervisor research accounts, and as such are a main limiting factor on the number of students that can be admitted to the Department. The value of a RA is set at the level required to bring eligible students’ income over the 12-month academic year up to the guaranteed minimum, after counting the TA and any scholarships the student has been awarded.

### ***University of Toronto Fellowships***

The University of Toronto Fellowships (UTF) constitute the University’s contribution to the guaranteed funding package. There are no eligibility restrictions for UTF based on citizenship or status in Canada, nor are students required to apply for UTF awards. Students are required to show progress in a satisfactory and timely fashion, as documented in the minutes of their supervisory committee meetings. 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***

Students awarded external scholarships will receive a portion of the total scholarship amount (typically

10-20%) as a top-up in addition to the minimum stipend amount. Students are strongly encouraged to apply for scholarships; in addition to being financially beneficial in the short term, they provide enduring long-term documentation of meritorious academic and research performance. Several prominent scholarships are described below (the School of Graduate Studies maintains a far more comprehensive list of scholarships, fellowships, loans, and bursaries at [www.sgs.utoronto.ca/currentstudents/Pages/Financing-Your-Graduate-Education.aspx](http://www.sgs.utoronto.ca/currentstudents/Pages/Financing-Your-Graduate-Education.aspx)).

## **External Scholarships**

### *Natural Sciences and Engineering Research Council (NSERC) of Canada*

Description: 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. 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 website ([www.nserc-crsng.gc.ca/](http://www.nserc-crsng.gc.ca/)).

Value: Post-Graduate Scholarships for Doctoral candidates (PGS D) are valued at \$21,000 per year. Canada Graduate Scholarships (CGS) must be held at a Canadian University, and for Master's (CGS M) and Doctoral (CGS D) candidates are valued at \$17,500 and \$35,000, respectively. Master's scholarships are awarded for one year with no renewal, and Doctoral scholarships may be awarded for two or three years.

Application deadline: early October (please contact the Graduate Administrator for further details). The Graduate Centre for Academic Communication (GCAC) offers a free, three-week course in writing NSERC proposals, sessions beginning in early September. More information can be found here: <https://www.sgs.utoronto.ca/currentstudents/Pages/GCAC.aspx>

### *Ontario Graduate Scholarships (OGS)*

Description: 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. Additional information and application forms are available from the SGS website (<http://www.sgs.utoronto.ca/currentstudents/Pages/Ontario-Graduate-Scholarship.aspx>)

Value: \$15,000 per year (three consecutive terms), up to a maximum of two years.

Application deadline: usually in the spring term (for further details, please email the Graduate Administrator ([s.moore@utoronto.ca](mailto:s.moore@utoronto.ca)) or Stacey Kwan, SGS Graduate Awards Office ([ogs@sgs.utoronto.ca](mailto:ogs@sgs.utoronto.ca))).

### *Queen Elizabeth II Graduate Scholarships in Science and Technology (QEII-GSST)*

Description: The Department of Earth Sciences has a number of QEII awards available each year to domestic and Permanent Resident graduate students. The award is designed to encourage excellence in graduate studies in science and technology.

Value: \$15,000 for one academic year

Application deadline: Applicants who apply for OGS awards are automatically considered for a QEII, and thus need not submit a separate application; therefore, to be considered for QEII, applicants must have applied for OGS.

### *Connaught Scholarship*

Description: This prestigious award from the University of Toronto is made to a meritorious doctoral-stream M.Sc. or Ph.D. international (visa) student. Nominees who will begin as master's students in a doctoral-stream program must intend to transfer to the graduate unit's doctoral program within the standard reclassification time period. For more information, please visit <http://connaught.research.utoronto.ca/>.

Value: The scholarship covers tuition and fees, with the Department and University still providing the \$18,500 stipend for living expenses

### *Ontario Trillium Scholarship*

Description: The Ontario Trillium Scholarships (OTS) program is a significant initiative to attract more of the best qualified international students to Ontario for Ph.D. studies. This program supports the 2010 Open Ontario commitment to increase the number of international students in Ontario while maintaining spaces for qualified domestic students. For more information, please visit <http://www.sgs.utoronto.ca/currentstudents/Pages/Gov-Funded-Awards.aspx>.

## **Internal Scholarships**

### *P.C Finlay Q.C. President's Fellowship in Geology and Dr. Norman Keevil President's Fellowship in Geology*

Description: For meritorious international PhD students from developing countries and who intend to take their expertise to developing nations, the Department of Earth Sciences offers these scholarships at the time of admission.

Value: Equal to the guaranteed funding package, and awarded for a term of study while the student is in the funded cohort; continuation may be granted upon review of the student's progress.

Application: candidates should submit a one-page statement of intent with their application for graduate study, outlining their plans for work/study in a developing nation upon graduation.

*Note that a number of other internal scholarships are available to Earth Sciences graduate students due to the generosity of our alumni and benefactors. There is no need to apply as all students are considered at the time of admission.*

## **Other Resources**

[School of Graduate Studies Awards Office](#)

[CUPE Tuition Assistance Fund](#)

### ***Full-Time Studies, Residency, and Employment***

Students registered as full-time students in the Department of Earth Sciences must satisfy the government regulations for full-time graduate studies. 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, Admissions, and Awards Committee. Some scholarships involve restrictions regarding additional work hours; students are responsible for determining the specific conditions of their scholarships. Any student who undertakes excessive extra 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.

# PROCEDURES FOR THE COMPLETION OF GRADUATE DEGREES

These notes should be read as guidelines for students and their faculty supervisors to follow. Students or their supervisors must consult with the Associate Chair for Graduate Studies before proposing any modifications.

## *First Steps for New Students*

The following administrative tasks should be completed by new students during late August and early September:

- (i) Acquire a University of Toronto ID card (also known as T-Card), which acts as your library card and student identification for numerous services. You must present proof of citizenship, identification and your offer of admission bearing your student number to the T-card office; please see <http://tcard.utoronto.ca/> for hours and location.
- (ii) Activate your UTORid (located on your student card) in order to set up a “@mail.utoronto.ca” email account at [www.utorid.utoronto.ca/cgi-bin/utorid/activate.pl](http://www.utorid.utoronto.ca/cgi-bin/utorid/activate.pl).
- (iii) Meet with the Graduate Administrator during the first week in September to discuss funding information and receive a mailbox, office, and fill in forms and leave a deposit to arrange keys to the building and your office.
- (iv) It is your responsibility to register and enroll in your courses on ACORN. You must be registered by **September 15** or you will be charged a late fee. The deadline to enroll in fall courses is **September 25**.
- (v) If you are part of the funded cohort, you are eligible to have your fees deferred without interest charges until April. You will need to select the fee deferral option on ACORN. Deferring your fees will automatically register you. Note that those in the funded cohort have their fees paid by the Department; do not pay them on your own if you are in the funded cohort! If you are not in the funded cohort and do not have a scholarship, please pay your fees no later than August 25 to avoid late penalties.
- (vi) Meet with Silvana Papaleo, the Business Officer, to complete the paperwork to arrange payment for your TA and RA. International students must bring a voided cheque (for banking purposes), their study permit, and their Social Insurance Number. Domestic students must bring their Social Insurance Number and a voided cheque.
- (vii) International students must receive a Social Insurance Number (SIN) in order to be properly paid. Please bring your student visa to the Graduate Administrator and he will compose the letter required by Service Canada. Please take your passport, your study permit, your admissions letter, and the letter from the Graduate Administrator to the Service Canada Office.
- (viii) International students must go to the International Student Centre at 33 St. George Street to arrange UHIP (University Health Insurance Plan for international students, employees, and dependents).
- (ix) For IT support (such as printing, Internet, and email listservs), meet with Jim Charters in office 4106.

## ***Course Work***

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”, or “NCR”), or does not complete a course (i.e., receives a non-grade report of “INC”), then the Graduate Affairs, Admissions, and Awards 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, Admissions, and Awards Committee for approval by the School of Graduate Studies) and obtain a grade of at least B.

To encourage breadth the Department permits students to substitute electives with equivalent courses outside Earth Sciences.

<b>Degree Program</b>	<b>Thesis?</b>	<b>Required Courses</b>	<b>Elective Courses</b>	<b>Total FCE</b>
M.Sc. (all-course)	No	ESS1101H, ESS3608H, one breadth course*	3.5 FCE	5.0
M.Sc. (doctoral-stream)	No	ESS1101H, ESS3601Y, ESS3603Y, one breadth course*	0.5 FCE	3.5
M.A.Sc.	Yes	ESS1101H, one breadth course*	1.0 FCE	2.0
Ph.D. (from internal doctoral-stream M.Sc.)	Yes	One breadth course*	0.5 FCE	1.0
Ph.D. (from external M.Sc. or direct entry)	Yes	ESS1101H, one breadth course*	0.5 FCE	1.5

\*The Earth Sciences breadth courses are listed on the Departmental website (<http://www.es.utoronto.ca/programs/graduate/courses/>); availability is subject to change by year.

## ***Supervisor-Student Responsibilities and Committee Meetings***

Students should meet with their supervisors as soon as possible to discuss their course selection, research program and the responsibilities of the supervisor and the student; more details may be found at [www.sgs.utoronto.ca/calendar/Pages/Graduate-Student-Supervision.aspx](http://www.sgs.utoronto.ca/calendar/Pages/Graduate-Student-Supervision.aspx).

Students enrolled in the M.A.Sc. and Ph.D. programs must form a supervisory committee and meet at least once a year to review and discuss progress. Supervisory committees are obligated to meet more frequently if a student is having difficulty with any aspect of their tenure within the Earth Sciences Department. The committee should consist of the supervisor plus two other members of the graduate faculty, chosen (with the supervisor's advice) based on expertise relevant to the student's research. The student is encouraged to be proactive in discussing the composition of a committee with the supervisor, and in scheduling an initial committee meeting during the first semester of enrolment.

At each meeting, the supervisory committee should:

- (i) Discuss research program.
- (ii) Discuss ongoing coursework.
- (iii) Prepare and sign minutes of the meeting on the form obtained from the Graduate Administrator, to whom it should be returned subsequent to the meeting.

## ***M.Sc. and M.A.Sc. Requirements***

The graduate research project must culminate in a written report (M.Sc. students) or thesis (M.A.Sc. students). The research should attack a significant scientific question, but need not involve extensive laboratory or field investigations. The written report of doctoral-stream M.Sc. students should be approximately 40 pages in standard format (i.e., 1" page margins, 1.5" spacing, 12-point font), although some reasonable deviation may be permitted depending on the project. The page limit includes diagrams and figures but excludes references and any appendices. There are no formal page limits for M.A.Sc. theses, but students are advised to be concise (e.g., not more than 150 pages). Large quantities of data can be included in appendices at the end of the thesis.

The members of the oral examination committee must be provided with a copy of the written report or thesis at least one week before the examination. Examining committees consist of the supervisor plus two other members of the graduate faculty recruited by the supervisor in consultation with the Associate Chair for Graduate Studies (or in the case of M.A.Sc. students, the supervisory committee members). The examination begins with a 20-minute oral presentation of the research project by the student, using visual aids where necessary. Questions from the examining committee follow. 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; the student then withdraws while the committee deliberates. The final grade (in the case of M.Sc. students) or the decision to award the degree (in the case of M.A.Sc. Students) is based on:

- (i) The quality and presentation of the written thesis
- (ii) Depth and breadth of knowledge relevant to the project demonstrated during the oral examination
- (iii) Originality, creativity, and potential research ability

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 Administrator.

## ***Ph.D. Requirements***

### **Thesis Proposal Defense**

This formal examination should be held within 8-12 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 pages (single spaced, minimum 12-point font) must be prepared by the candidate. This proposal should contain:

- (i) An abstract of no more than 250 words
- (ii) A clear statement of the research problem and objectives
- (iii) A brief critical review of the directly relevant literature
- (iv) An outline of the research methodology describing the measurements and observations to be made
- (v) A discussion of how the measurements and observations will address the problem identified in (ii) above
- (vi) 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 in consultation with the student and the Associate Chair for Graduate Studies. 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 with the permission of the candidate and examining committee, but the audience is generally excluded during the question period.

Upon completion of questioning, the candidate must withdraw while he/she is evaluated on:

- (i) The quality and defense of the written thesis proposal
- (ii) Depth and breadth of knowledge in the chosen area of study, including relevant basic science
- (iii) The scientific merit of the research problem and level of innovation in approach to solving it
- (iv) The likelihood of achieving success in the research in a four-year period

- (v) Originality, creativity, and ability to make critical judgments on scientific matters

The examining committee, following appropriate discussion, will 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 to repeat the thesis proposal examination within six months; if they fail the second time, they must withdraw from the program.

Minutes of a 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 Administrator.

### **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. While the imposition of page limits would be inappropriate, students are advised to be concise (e.g., not more than 150 pages). Large quantities of data can be included in appendices at the end of the thesis.

Alternatively, an increasingly popular mode of thesis preparation is a series of papers prepared for submission to journals for publication. Because of journal formatting requirements, a certain amount of repetition may be unavoidable (e.g., provision of sample location information or experimental protocols); therefore, in order to provide coherence to the research program the candidate is required to write an introductory chapter that sets out the objectives and explains how the chapters relate to each other. A final chapter providing a synthesis or summary must also be prepared 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 accepted for publication. 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.

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 spelled out 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.

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 one copy in digital form of the final accepted thesis (see below). Two CDs of the final, corrected thesis (one for the Department archives, one for the Noranda Library) must be submitted to the Graduate Administrator. It is a courtesy to provide at least the supervisor with a copy of the thesis, though additional copies may also be prepared for members of the examining committee.

For more information, check Guidelines for Producing your Thesis in the section on Program Completion on the School of Graduate Studies web site (<http://www.sgs.utoronto.ca/currentstudents/Pages/Program-Completion.aspx>).

## **Final Committee Meeting**

Prior to the Ph.D. thesis defense, the candidate must hold a final committee meeting in which the supervisory committee members are asked to agree whether the submitted thesis is defensible and the student is prepared for the defense.

## **Departmental Oral Defense**

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

It is the candidate's responsibility to book the Rio Algom Room for the Departmental defense with the receptionist and copy the Graduate Administrator.

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 two weeks before the examination, the exact time to be negotiated with the examining committee. In normal circumstances, the supervisory committee will have read various drafts of the thesis and should be sufficiently familiar with the content to 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 chair of the examining committee will record the results of the minutes on a Graduate Advisory Committee Assessment Form.

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). The candidate is informed of the results of the examination immediately following the vote. 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 Departmental examination should be filed with the Graduate Administrator. Informal discussions with the supervisor regarding the results of the examination are also suggested for the benefit of the candidate.

In the event of a failure, which implies that the Departmental 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 the Departmental approval; however generally the candidate is strongly advised to retake the Departmental defense, incorporating all necessary revisions.

At the time of a successful Departmental defense, the examining committee discusses possible candidates for external examiners to be invited to participate in the Senate defense. If at all possible, the external appraiser should be at the equivalent of associate professor level or higher.

## **Senate Defense**

Candidates are advised that, upon submission of the final version of the thesis, the School of Graduate Studies requires six weeks to arrange for a Senate defense. Requests to shorten this time are discouraged because they place an unreasonable workload upon the Graduate Administrator, the external appraiser, and the School of Graduate Studies.

The Ph.D. Senate examining committee must consist of four to six persons and must include at

least two members outside of the supervisory committee. The School of Graduate Studies recommends including three non-supervisory members to ensure that the exam proceeds as scheduled. One of the non-supervisory members of the committee is the external examiner from another institution, typically an internationally acknowledged expert in the candidate's field of specialization. This individual is also required to submit a written appraisal of the thesis for circulation to the candidate and examining committee two weeks prior to the Ph.D. Senate defense. The external examiner usually attends the examination, but may submit a list of questions if attendance is not possible. The School of Graduate Studies provides the examination chair who ensures that all regulations and procedures are correctly followed. Regulations and procedures for the conduct of the Senate defense are provided by the Graduate Administrator at the time of the examination.

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.

The candidate:

- (i) Books the Rio Algom Room with reception and informs the Graduate Administrator.
- (ii) Submits to the Administrator the abstract and the exact thesis title.
- (iii) Sends the complete (unbound or electronic) thesis to the examining committee at least four weeks before the Senate defense.
- (iv) Following the successful defense and making all corrections, the candidate consults the SGS website for uploading the corrected thesis.
- (v) Provides two CDs of the finished, corrected thesis to the Graduate Administrator.

The supervisor:

- (i) Notifies the Graduate Administrator of the membership of the Senate defense committee, the date, time and place of the Ph.D. Senate defense, and the name and affiliation of the external examiner.
- (ii) Instructs the external appraiser to contact the Graduate Administrator by email. The external appraiser submits a complete CV including publications. This should include when each milestone in the professor's designation was completed (assistant professor, associate professor, etc.). The external appraiser's email, full address, and fax number should also be on the CV.
- (iii) Arranges for a digital copy of the final thesis to be sent to the external appraiser. If a hard copy is requested by the External Appraiser, the Graduate Administrator will arrange to have it sent by courier.
- (iv) While the Department of Earth Sciences will reimburse the external appraiser up to \$500 for his/her expenses, it is understood that anything over that initial \$500 is paid by the supervisor.
- (v) When the corrections are made to the thesis, the supervisor notifies the Graduate Administrator that all corrections have been made.

The external appraiser:

- (i) Sends his/her full CV to the Graduate Administrator so that the information can be inputted on ROSI and the Vice-Dean is alerted. The Vice-Dean will decide if the external

- appraiser is acceptable.
- (ii) Submits the formal external appraisal to the Graduate Administrator at least two weeks before the Senate defense.
- (iii) Submits the External Appraiser ID Form to the Graduate Administrator so that the honorarium can be arranged.
- (iv) Submits an expense reimbursement form along with receipts to the Business Officer.

The Graduate Administrator:

- (i) Submits the CV of the proposed external appraiser to SGS for final approval.
- (ii) Books the Senate defense on ROSI and informs SGS, who then puts out the call for an examination chair.
- (iii) Notes the thesis title on ROSI.
- (iv) Sends a copy of the abstract to SGS.
- (v) The Graduate Administrator, on behalf of the Chair of the Department, sends the external appraiser a formal letter engaging him/her for the task. Included in the package is an External Appraiser ID Form so that the external appraiser can be paid an honorarium.
- (vi) When the external appraisal is submitted the Graduate Administrator sends a copy to the candidate, the Senate defense committee, and SGS.
- (vii) When SGS informs the Graduate Administrator of the chair for the defense, the Administrator prepares the exam file with the rules for the conduct of the defense, the abstract, the external appraisal, the chair's summary, and voting ballots. This is given to the chair at the time of the exam.
- (viii) A day before the examination the Administrator sends a reminder email to the chair.
- (ix) While the defense is in progress the Administrator prepares a memo requesting that an honorarium be prepared to be sent to the external appraiser.

## RESEARCH AND LIBRARY FACILITIES

The Department of Earth Sciences 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 (with access to high speed network connections and printing) is allocated to all students whose supervisor is based at the St. George Campus. The research groups of individual faculty members carry out their work in laboratories designed and equipped to meet their specialized needs.

Below are listed the major technical facilities (and relevant contact information) in the Earth Sciences Department:

*Scanning Electron Microscopy*      *George Kretschmann ([george@es.utoronto.ca](mailto:george@es.utoronto.ca))*

*Electron Microprobe*      *Yanan Liu ([liu@es.utoronto.ca](mailto:liu@es.utoronto.ca))*

*Laser Ablation Inductively Coupled Plasma Mass Spectrometry*      *Colin Bray ([cjbray@es.utoronto.ca](mailto:cjbray@es.utoronto.ca))*

*Sample Preparation/Polishing*      *George Kretschmann ([george@es.utoronto.ca](mailto:george@es.utoronto.ca))*

Note that other facilities such as X-Ray Diffraction, X-Ray Fluorescence, Neutron Activation Analysis, Gas Chromatography, Ion Chromatography, and Atomic Force Microscopy may be available to students (contact Mike Gorton at [gorton@es.utoronto.ca](mailto:gorton@es.utoronto.ca) for more details). Further information on both faculty research facilities and Departmental facilities may be found under the Research tab at [www.es.utoronto.ca](http://www.es.utoronto.ca).

The library system at the University of Toronto ([www.library.utoronto.ca](http://www.library.utoronto.ca)) ranks as the largest academic library in Canada, and is third among leading research universities in North America. There are over 44 integrated libraries at three campuses, many of which feature quiet study space or group study rooms, computing facilities, reference help, and specialized collections pertaining to specific subject areas.

The Noranda Earth Sciences Library, immediately adjacent to the Department of Earth Sciences at 5 Bancroft Avenue, 2nd Floor, contains the major geoscience collections at the university. Materials include a large collection of books, journals, and theses as well as government and technical reports, although older periodicals are typically kept in the stacks located in the basement of the Gerstein Library. The staff at the Noranda Earth Science Library provides reference services and consultation to help carry out effective search strategies for research in geology.

### ***University of Toronto Mississauga (UTM)***

The Erindale Campus of the University of Toronto Mississauga is situated in a picturesque setting along the Credit River, some 40 minutes away by car 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)***

The 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. The Department of Earth Science includes several faculty members cross-listed with the Department of Physical and Environment Science at UTSC, providing many opportunities for interdisciplinary work. 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 (ROM)***

The Royal Ontario Museum is located on the northeast corner of the St. George 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.

## FACULTY AND RESEARCH INTERESTS

Bank, Charly, B.Sc., M.Sc., Ph.D.	Geophysics
Bergquist, Bridget, B.Sc., Ph.D.	Metal geochemistry
Bollmann, Jörg, DPhil	Paleoceanography, geobiology, paleoecology
Cowling, Sharon, B.Sc., M.Sc., Ph.D.	Global carbon cycle
Davis, Don, B.Sc., M.Sc., Ph.D.	Geochronology
Desloges, Joe, B.E.S, M.Sc., Ph.D.	Fluvial geomorphology, glaciolacustrine sedimentation, paleohydrology
<u>Diamond, Miriam</u> , B.Sc., M.Sc., Ph.D.	Environmental chemistry
<u>Dittrich, Maria</u> , B.E.S., M.Sc., Ph.D., D.Sc.	Biogeochemistry, geomicrobiology (UTSC)
<u>Eyles, Nick</u> , B.Sc., M.Sc., Ph.D., D.Sc.	Glacial geology (UTSC)
<u>Ferris, Grant</u> , B.Sc., Ph.D.	Microbial geochemistry
<u>Finkelstein, Sarah</u> , AB, M.Ph., Ph.D.	Paleoecology, paleoclimatology
<u>Ghent, Rebecca</u> , B.A, M.Sc., Ph.D.	Remote sensing, planetary surfaces, tectonics
<u>Halfar, Jochen</u> , Ph.D.	Paleoclimatology, geobiology (UTM)
<u>Hamilton, Mike</u> , B.Sc., Ph.D.	Geochronology
<u>Henderson, Grant</u> , B.Sc., M.Sc., Ph.D.	Amorphous materials, high T and P geochemistry
<u>Howard, Ken</u> , B.Sc., M.Sc., Ph.D.	Hydrogeology, water resources (UTSC)
<u>LaFlamme, Marc</u> , Ph.D.	Paleontology, geochemistry (UTM)
<u>Miall, Andrew</u> , B.Sc., Ph.D., D.Sc., FRSC	Basin analysis, stratigraphy, sedimentology.
<u>Pysklywec, Russ</u> , B.Sc., Ph.D.	Geodynamics and tectonics
<u>Rudkin, Dave</u> , B.Sc.	Paleobiology and paleoecology
<u>Schoenbohm, Lindsay</u> , B.A., Ph.D.	Neotectonics and landscape evolution (UTM)
<u>Schulze, Dan</u> , B.A., M.Sc., Ph.D.	Upper mantle petrology, diamonds (UTM)
<u>Sherwood-Lollar, Barbara</u> , B.A., Ph.D.	Stable isotope geochemistry
<u>Wortmann, Uli</u> , B.Sc., M.Sc., Ph.D.	Marine Geology, paleoceanography, carbon and sulfur cycling, geomicrobiology
<u>Zajacz, Zoltan</u> , M.Sc., Ph.D.	High PT Geochemistry, ore deposits
<b>Cross-appointed and Status-only Faculty</b>	<b><i>(to be updated)</i></b>
Brenan, James, B.Sc., Ph.D.	High temperature geochemistry
Caron, Jean Bernard, M.Sc., Ph.D.	Paleobiology, paleoecology (ROM)
Head, Martin, B.Sc., M.Sc., Ph.D. (status	Marine palynology, organic maturation
Lowman, Julian, B.Sc., M.S., Dphil	Mantle dynamics, numerical modelling (UTSC)
Tait, Kim, B.Sc., M.Sc., Ph.D.	Mineralogy, crystallography, meteoritics (ROM)
Simpson, Myrna, B.S., DPhil	Environmental organic geochemistry (UTSC)
Wells, M., B.S., Dphil	(UTSC)
Young, R.P., B.Sc., M.Sc., Ph.D., FGS., FRSC.	Seismology and rock mechanics (Civil Engineering)

### Emeritus Faculty

Anderson, Greg, BEng., M.A.Sc., Ph.D.

Bailey, Richard, B.Sc., Ph.D.

Fawcett, Jeff, B.Sc., Ph.D.

Gittins, John, B.Sc., M.Sc., Ph.D., Sc.D.

Halls, Henry, B.Sc., M.Sc., Ph.D.

McAndrews, John, B.Sc., M.Sc., Ph.D.

Naldrett, Tony, M.Sc., Ph.D.

Norris, Geoff, B.A., M.A., Ph.D., FRSC

Robin, Pierre, B.Sc., M.Sc., Ph.D.

Rucklidge, John, B.A, Ph.D.

Schwerdtner, Fried, DrRerNat, DipGeol.,  
B.Sc., Ph.D.

Scott, Steve, B.Sc., M.Sc., Ph.D.

Spooner, Ed, B.A., Ph.D.

von Bitter, Peter, B.A., M.A., Ph.D.

Westgate, John, B.Sc., Ph.D.

Geochemistry, thermodynamics

Geophysics and tectonics

Metamorphism, flood basalts

Igneous petrology, carbonatites

Paleomagnetism, tectonics

Quaternary biostratigraphy/climate, palynology

Magmatic ores, nickel, PGE

Palynology

Structural and metamorphic geology, geodynamics,  
numerical methods in geology

AMS, meteorites, radionuclides

Structural geology, shield terrains

Marine geology, ore deposits

Fluid geochemistry, ore deposits

Invertebrate paleontology

Tephrochronology