

# Laurentian University Department of Earth Sciences Graduate Handbook

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## Introduction

The Department of Earth Sciences at Laurentian University offers a M.Sc. in *Geology* that can be obtained through a research-based thesis program, or an applied modular coursework option. The Department also offers a directed thesis based Ph.D. Program in *Mineral Deposits and Precambrian Geology*.

*Mineral Deposits* includes study of the geology, mineralogy, geochemistry, structural geology, geophysics, and genesis of mineral deposits and the geology of ore-forming environments.

*Precambrian Geology* includes the study of the early Earth's geodynamic, tectonic, igneous, metamorphic, sedimentary, biological, geochemical, and structural evolution, together with study of the evolution of the ocean-atmosphere system.

**The M.Sc. Geology – Thesis based option** has been offered since 1970, when it was introduced as the first graduate degree program at Laurentian University. Students take four 3-credit (one term) courses, and undertake a research-based thesis. Graduates of the M.Sc. program can proceed to a professional career in industry or government, or can seek entrance to a Ph.D. program.

**The M.Sc. Geology – Mineral Exploration option** was initiated in January 2000, and is directed at industry-based geologists. It provides an innovative approach in program delivery by utilizing team-taught, multidisciplinary, modular courses. Participants are recommended to have a minimum of two years experience beyond a B.Sc. (Hons), and are typically continuously employed in the geosciences, in industry or government during their participation in the program. Candidates participate in six 3-credit Modular Courses (delivered on and off campus) and are required to undertake a minor research project related to their current workplace. The program is designed for them to enhance their professional skills in order to ensure more informed performance in their workplace.

**The thesis based Ph.D. program** in *Mineral Deposits and Precambrian Geology* was approved in the fall of 2003. To graduate a student must complete, either six one-term (three credit) graduate-level courses beyond the B.Sc. (Hons) level, or four one-term graduate-level courses beyond the M.Sc. level, in addition to a research based thesis.

## Intellectual Development and Educational Experience

Student courses will be selected in consultation with supervisory committees in order to provide the best educational basis for the student's development and research objectives. Compulsory participation of all M.Sc. and Ph.D. students in the seminar courses (GEOL 5007E and GEOL 6007E, respectively) is designed to expand their background knowledge and expose them to a broad range of research concepts in Mineral Deposits and Precambrian Geology (see Table 5.1, course requirements).

In addition to the seminar courses, the Department hosts numerous visiting speakers. The *Sudbury Geological Discussion Group* also convenes monthly seminars by visiting researchers. Students are encouraged to present the results of their research at national and international meetings. Support to attend these meetings is normally be provided from the supervisor's research grant or external sources (e.g., SEG

and MAC travel grants). Students in these programs are exposed to an invigorating intellectual environment in the fields of geology and mining.

## Program Regulations

### Application Procedures

Applications by students who wish to enter the M.Sc. and Ph.D. Programs must be submitted *on line* to the Laurentian University Admissions Office and the file is forwarded to the Department. Applications are evaluated by all faculty in the Department of Earth Sciences. For acceptance, a clear majority of the faculty must support the application. The intention is to accept only students of the highest calibre into the programs.

### Admission Requirements

**M.Sc. Geology - Thesis Based Option:** B.Sc. Honours degree with a minimum B average and supporting reference letters.

**M.Sc. Geology – Mineral Exploration option:** Entrance is restricted to geoscientists holding a B.Sc. degree in the Earth Sciences (minimum B average), *at least two years* of industrial or equivalent experience, and supporting reference letters. Admission is competitive and applicants are evaluated on the same criteria as the thesis based option.

**Ph.D. Mineral Deposits and Precambrian Geology:** Admission to the program will be granted by the Director of the School of Graduate Studies on the recommendation of the Department of Earth Sciences. Applicants for admission to the Ph.D. program must normally possess a Masters degree, or equivalent, from a recognized university, college, or institute with a minimum average grade of B+. Applicants must provide evidence of suitable educational background and potential for advanced research in their selected discipline. Letters from referees, professional experience, and publication records are additional criteria that may be taken into consideration for admission. At the time of admission, the student or their principal advisor is expected to submit a preliminary research plan to the Ph.D. coordinator.

Students initially admitted as M.Sc. candidates may progress to a Ph.D. program without completing a M.Sc. degree. Such a transfer may take place no later than the beginning of the sixth full-time term of graduate enrolment (i.e., the request for a change of status must be received during the fifth term). The residency period for the Ph.D. degree will be one year from the point in time of transfer. Transfer requires re-application (on-line), with a cover letter from the students committee, approved by the graduate coordinator (this letter will go directly from the graduate secretary to admissions with a copy to graduate studies, confirming approval of the transfer. This will normally be accompanied by a progress report (see below).

### Degree Requirements

#### ***M.Sc. Geology – Thesis-Based Option***

At the time of admission to the program, a Principal Supervisor, in consultation with the Department, will establish an Advisory Committee for the student. The Advisory Committee will assist in selecting the coursework and directing the research program to meet the needs of the student. In addition, the Advisory Committee and student will meet at least once per year and provide documentation of the progression of the student, the form of which is submitted to the graduate office. The M.Sc. thesis-based program normally consists of four one-term GEOL graduate courses, plus a thesis (GEOL 5000 E). The department may recommend that in individual cases, other suitable fourth-year undergraduate courses may be taken in addition to the normal graduate load.

### ***M.Sc. Geology – Mineral Exploration Option***

In order to graduate a student must take all six of the short-course modules listed below (no options); note that other courses of equal credit and focused on aspects of mineral exploration may also be taken for credit with the permission of the Program Coordinator. These will normally be offered at a rate of three to four per year (September, December, March, April) on a two-year cycle. Students may enter at any time. The modular courses are taught by members of the Department of Earth Sciences, MERC, and by outside experts. In addition, the candidates are expected to complete an applied research project (GEOL 5055 E). The scope and topic of the research project will be determined by the Program Coordinator and an assigned faculty supervisor, and will focus on a problem of interest to the candidate's employer, typically in one of their active exploration or mining areas.

*Courses required include:*

**GEOL 5055 E Applied research project**

**\*GEOL 5307 E Structure, tectonics and mineral exploration**

**\*GEOL 5326 E Mineral exploration in volcanic terrains**

**GEOL 5606 E Exploration for magmatic ore deposits**

**GEOL 5607 E Exploration for hydrothermal ore deposits**

**GEOL 5806 E Exploration geochemistry**

**GEOL 5956 E Exploration geophysics**

*\* Indicates field-based modules taught off campus.*

### ***Ph.D. in Mineral Deposits and Precambrian Geology***

At the time of admission to the program, a Principal Supervisor, in consultation with the Department, will establish an Advisory Committee for each Ph.D. This will include a Principal Supervisor and two or more secondary advisors, who may be core or adjunct faculty. The Ph.D. Advisory Committee will assist in selecting the coursework and directing the research program to meet the needs of the student. They may recommend additional courses and readings to provide the student with sufficient background to successfully complete a Ph.D. Qualifying Examination. The Advisory Committee and student will meet at least once per year and provide documentation of the progression of the student, the form of which is submitted to the graduate office.

In order to graduate, a Ph.D. student must successfully complete:

- 1) Six one-term graduate-level courses or course equivalents beyond the B.Sc. level, or four one-term graduate-level courses beyond the M.Sc. level. In either case, one of the courses shall be the Ph.D. Graduate Seminar (GEOL 6007 E).
- 2) A Ph.D. Research Proposal: Students entering the Ph.D. program must submit a written Ph.D. Research Proposal to the Department within nine months of registration. The proposal should identify the research problem and include a critical review of the relevant literature. It should provide clearly defined objectives and information on research methodology and indicate the potential results and their implications. The proposal must be approved by the Ph.D. Advisory Committee, and the Department, in order for the student to proceed to the Ph.D. Qualifying Examination.
- 3) A Ph.D. Qualifying Exam: Students registered in the Ph.D. program with a M.Sc. degree must pass an oral Ph.D. Qualifying Examination within 18 months of registration. The Ph.D. Qualifying Examination Board will consist of the Ph.D. Advisory Committee and at least one other member of the Department or adjunct faculty. The Director of the School of Graduate Studies or a designated

alternate will chair the examination. Students transferring from the M.Sc. to Ph.D. program without first completing the M.Sc. program must pass the Qualifying Examination within 12 months of the transfer or within 24 months of first registration in the M.Sc. program, whichever period is longer (More details on comps below).

The Ph.D. Qualifying Examination will involve a brief oral summary of the research proposal, including details of work to date, work in progress, and a plan for completion. Following the presentation, the student will be asked questions on the thesis topic and three related major subject areas. They will also be expected to demonstrate knowledge of associated geological disciplines pertaining to their thesis topic. Typically this will involve questions in three specific subareas decided in advance by the Advisory Committee and approved (along with the exam date) by the Graduate Secretary.

The decision of the Ph.D. Qualifying Examination Board will be one of the following: (1) pass without conditions, (2) pass with conditions, (3) fail with an opportunity to retake the exam, or (4) fail without an opportunity to retake the exam (i.e., removed from the program). In options 2 and 3 the student will be provided with the reasons for their assessment and a list of recommended remedial actions, which may include taking one or more undergraduate or graduate courses and/or studying a list of texts/research papers. A student is allowed a second opportunity to appear for the Qualifying Examination within six months of notification of failure. A grace period will only be permitted if the recommended courses were not offered during this interval. After a second failure, the student will be required to withdraw from the Ph.D. program.

## **Residence Requirements**

A minimum of one year of full-time residence is required for all Ph.D. students. The minimum period of study is two years (full-time) for candidates holding a M.Sc. degree or three years (full-time) for candidates entering the program with a B.Sc. Honours degree or equivalent.

## **Role of the Ph.D. Advisory Committee**

Each student will have an Ph.D. Advisory Committee consisting of a Primary Supervisor and two or more faculty or adjunct faculty members. Additional members may be selected from other departments, universities, and/or government or industrial organizations, providing they have appropriate expertise in the area of research. The role of the Advisory Committee is to provide direction and advice from the beginning to completion of the program. Each student is required to submit a written and oral annual progress report and research plan for the following year to their Advisory Committee in a formal meeting at least once a year. Subsequently, the Advisory Committee is required to file the student's report with the Ph.D. coordinator and to provide both the coordinator and student with written comments on the candidate's progress.

## **Transfer from the M.Sc. to the Ph.D. Program**

A student with a B.Sc. Honours degree will not normally be admitted directly into the Ph.D. program. M.Sc. students wishing to transfer to the Ph.D. program without completing a M.Sc. thesis must first obtain a recommendation from their M.Sc. Advisory Committee. The Department will then evaluate each application on a case-by-case basis, taking into account the performance of the student in graduate courses and research.

## **Part-Time Studies**

Full time students in the M.Sc. programs are expected to complete all requirements within a two to four year period. Part time students may be registered for a maximum of six years. The availability of six graduate level courses in modular-course mode in the Mineral Exploration option (three per year) greatly

facilitates participation by students who have full time positions in industry.

Ph.D. students have a minimum residency period of one year (which can be spread over a three year interval). The incorporation of modular courses into the Ph.D. program will permit the inclusion of similar qualified “non-traditional” students, while allowing them to self-finance their studies by continued employment in industry. Students in this group will normally pursue research directly related to the interests of their employer. All students must meet the minimum residence requirement of the Ph.D. program by negotiating one or more academic leaves of absence from their workplace.

## **Graduate Courses**

The Department currently offers twenty two-credit (one-term) courses at the graduate level, of which sixteen pertain directly to Mineral Deposits and Precambrian Geology that are available to both Ph.D. and M.Sc. students. All full-time M.Sc. students in the Thesis based option are expected to participate in the M.Sc. Graduate Seminar course (Geol 5007 E), and all Ph.D. students are required to participate in the Ph.D. Graduate Seminar course (Geol 6007 E) in order to gain further experience in organizing and presenting geological concepts and defending their interpretations before an audience of faculty and peers. Students at the M.Sc. level may take up to three credits (one one-term course) of any approved course at a Fourth-year undergraduate level if so approved by their Graduate Advisory Committee.

### ***Current Course Offerings at the Graduate Level***

**GEOL 5000 E Thesis**

**GEOL 5006 E Research Techniques in Geology**

**GEOL 5007 E Research Seminar in Geology**

**GEOL 5055 E Applied Research Project (Applied MSc program only)**

**GEOL 5107 E Advanced Mineralogy**

**GEOL 5206 E Topics in Igneous Petrology**

**GEOL 5207 E Topics in Metamorphic Geology**

**GEOL 5216 E Advanced Sedimentology**

**GEOL 5217 E Applied Sedimentology**

**GEOL 5307 E Structure, Tectonics, and Mineral Exploration**

**GEOL 5317 E Topics in Applied Remote Sensing**

**GEOL 5326 E Mineral Exploration in Volcanic Terrains**

**GEOL 5406 E Paleoecology of Ancient Environments**

**GEOL 5407 E Evolution and Fossil Record**

**GEOL 5416 E Global Change - The Geologic Record**

**GEOL 5606 E Exploration for Magmatic Ore Deposits**

**GEOL 5607 E Exploration for Hydrothermal Ore Deposits**

**GEOL 5806 E Exploration Geochemistry**

**GEOL 5906 E Topics in Shield Geology**

**GEOL 5956 E Exploration Geophysics**

## **GEOL 6000 E Thesis**

## **GEOL 6007 E Research Seminar in Geology**

### ***Graduate Course Descriptions***

## **GEOL 5000 E Thesis (see below for guidelines)**

## **GEOL 5006 E Research Techniques in Geology**

This course is designed to train students at the graduate level in a wide variety of techniques commonly used to collect standard types of data used in geological research. These techniques include x-ray diffraction; x-ray fluorescence; wet chemical techniques for dissolving silicate rock materials; atomic absorption spectrophotometry; H<sub>2</sub>O and CO<sub>2</sub> analysis; U-stage optical techniques; and methods of storing, retrieving and analyzing data using the department's inter-active computer terminal. Other techniques to be added as they become available. In the lecture portion of this course, the theoretical basis for each technique will be discussed. Practical applications of each technique to geological problems will be strongly emphasized. Students will be required to show competence in each of the techniques to successfully complete the course. cr 3

## **GEOL 5007 E Research Seminar in Geology**

Students will present two seminars, one of which must be on a topic in a field of research other than their thesis. Topics will be chosen in consultation with their departmental supervisor. Lectures in this course will address all aspects of seminar preparation and presentation at a standard appropriate for professional meetings. One meeting per week during the fall and winter terms to a maximum of 4 terms or upon submission of thesis. cr 3

## **GEOL 5055 E – Applied Research Project**

This course is required for and limited to students enrolled in the Course Work Masters option in Geology. Students will register for the course each semester that they are enrolled in the program. They will select a research topic in consultation with a faculty advisor during the first course module, prepare a research proposal for evaluation at the second course module, present short seminars during successive course modules, and submit the results of their research in a written format. It is expected that full-time students will complete the research project course within two and one-half years after the date of initial enrolment. cr 6

## **GEOL 5107 E Advanced Mineralogy**

A lecture-seminar course on the structure, crystal chemistry, phase equilibria, and natural occurrences of the more common rock-forming minerals. Prerequisite to the course is an adequate undergraduate background in mineralogy, igneous and metamorphic petrology, and economic geology. cr 3

## **GEOL 5206 E Topics in Igneous Petrology**

This is a lecture-seminar course covering selected topics in igneous petrogenesis. Students will also undertake a major term project selected in consultation with the professor. cr 3

## **GEOL 5207 E Topics in Metamorphic Geology**

This course covers selected topics in metamorphic petrology and geochemistry. Current periodical literature will normally form the basis of discussion topics. Lectures, student seminars and field excursions will be the presentation format. cr 3

## **GEOL 5216 E Advanced Sedimentology**

Physical and chemical processes of the sedimentary cycle; various continental and marine sedimentary

environments; facies relationships as controlled by tectonism. Other topics considered to suit individual needs. cr 3

### **GEOL 5217 E Applied Sedimentology**

Use of facies models in the interpretation of the structural, stratigraphic and sedimentary framework of depositional basins. Application of sedimentary facies models to hydrocarbon exploration and exploitation. cr 3

### **GEOL 5307 E - Structure, Tectonics, and Mineral Exploration**

This course will address the tectonic and structural controls on the localization and genesis of mineral deposits. It will examine regional tectonic settings, regional structural controls, and local structural controls, using the lode Au deposits in the Abitibi belt as a case study. The course is normally given in a field trip mode and will include evening lectures and field/underground mapping exercises. All field costs will be borne by the student. cr 3

### **GEOL 5317 E Topics in Applied Remote Sensing**

Topics covered in this course will be selected from applications of remote sensing to geological, land cover and water quality mapping. cr 3

### **GEOL 5326 E Mineral Exploration in Volcanic Terrains**

This course will focus on: a) the products and deposits formed by volcanic eruptions; b) eruptive processes and styles; c) mechanisms of emplacement, and d) landforms produced. Special emphasis will be placed on mineralisation and alteration processes associated with hydrothermal systems in both submarine and subaerial environments and the application of information gained from these systems to exploration. The course is normally given during a 10-12 day field trip. All field costs to be borne by the student. cr 3

### **GEOL 5406 E Paleocology of Ancient Environments**

The application of paleoecological principles and theory to the analysis of ancient environments. The distribution of major ecosystems in time and space: paleobiogeography of the Phanerozoic. Terrestrial paleoeco-systems: fossil faunas and floras of upland to lowland environments, equatorial and polar latitudes; lacustrine and fluvial settings. Coastal paleoenvironments: estuaries, deltas, supratidal and intratidal settings. Marine paleoenvironments: Shelf settings, siliciclastic and carbonate, the slope, reefs. The deep sea and its fossil record: refugia during mass extinctions. cr 3

### **GEOL 5407 E Evolution and Fossil Record**

Evolutionary models in paleontology: gradualism versus punctuated equilibria. The species problem; evolution at the population and species level. Large-scale evolution, mechanisms for change, evolutionary rates of animal and plants. Quantum speciation Species selection, turnover and role of sexuality through time. Extinctions, diversity maxima, declines. Ontogeny and phylogeny. Evolution of communities and ecosystems; geological evolution of the planet, plate tectonics, climate. Applied evolution - biostratigraphy. Evolution and taxonomy. cr 3

### **GEOL 5416 E Global Change - The Geologic Record**

This course examines the long-term record of global change as reflected in sedimentary rock, fossil faunas and floras and low-temperature isotope geochemistry. Topics to be considered will include: major changes in biogeochemical cycling processes of carbon, phosphorus, nitrogen, and sulphur through geologic time; lithosphere-ocean-atmosphere interactions; sedimentary suites as paleoclimatic keys; siliciclastics, tillites, paleosols, carbonates, evaporites, laterites, phosphorites, coals; sedimentary processes related to global change: e.g. sea level changes, storm events, climate cycles; fossils as

paleoclimatic keys: reefs and reef organisms, stromatolites, coralline fossils, shelly fossils, paleobotany and palynology; plate tectonic models and mountain-building as forcing mechanisms for climatic change, extra-terrestrial forcing (e.g. Milankovic cycles, impacts, etc.). cr 3

### **GEOL 5606 E Exploration for Magmatic Ore Deposits**

This course focuses on the geology and petrogenesis of magmatic ore deposits. Deposit types will include Ni-Cu-PGE sulphide, chromite, magnetite, and ilmenite deposits. Emphasis will be placed on the processes responsible for their formation and the features pertinent to exploration. cr 3

### **GEOL 5607 E Exploration for Hydrothermal Ore Deposits**

This course focuses on the geology, alteration, and origin of hydrothermal ore deposits. Deposit types will include epithermal and mesothermal precious metal, porphyry Cu and Cu-Au, VMS, and sediment-hosted (e.g., red bed, uranium, carbonate, SEDEX) deposits. Emphasis will be placed on the processes responsible for their formation, the recognition of alteration halos, and the features pertinent to exploration. cr 3

### **GEOL 5806 E Exploration Geochemistry**

This course addresses the principles and methods of geochemical exploration, including planning, sampling, geochemical analysis, data handling, and interpretation. It will include case histories of stratiform PGE deposits in layered intrusions, magmatic Fe-Ni-Cu-(PGE) sulphide deposits in ultramafic lavas, porphyry Cu deposits, volcanic-associated Cu-Zn-(Pb) deposits, Archean lode gold deposits, sedimentary-exhalative Pb-Zn-Cu deposits, and diamond exploration. cr 3

### **GEOL 5906 E Topics in Shield Geology**

The scope of this course includes concepts of Precambrian crustal evolution; the synthesis of wide-ranging geological data in modeling the evolution of Precambrian cratons, as well as discussion of the most recent field work in the Canadian Shield, especially in Ontario. cr 3

### **GEOL 5956 E - Exploration Geophysics**

This course will focus on the application of magnetic, gravity, and electrical techniques in mineral exploration, including remote sensing, image processing, and geographic information system (GIS) management. cr 3

### ***GEOL 6000 E – Thesis (see below for guidelines)***

### ***GEOL 6007 E – Ph.D. Research Seminar in Geology***

Full time students registered in the Ph.D. program will present a one-hour seminar, once per term, to a maximum of 6 terms (2 per year). Topics will be chosen in consultation with their thesis supervisor and will alternate between thesis-related material and topics of active, current interest in the earth sciences. Part-time Ph.D. students must present one seminar in each year of their Ph.D. studies to a maximum of 6 seminars. cr 3.

## **Language Requirements**

There are no formal language requirements in the M.Sc. or Ph.D. Programs, but entering foreign students must meet the requirements set out by the university and faculty check into this when accepting foreign students where English is not their first language. Students normally prepare material in the language of instruction (English), but may present written material in courses in either of Canada's official languages, providing prior consent has been received from the instructor.

## Procedures for PhD Research Proposal Evaluation and Qualifying Examination

- 1) Students entering the PhD program must submit a written PhD Research Proposal to their PhD Advisory Committee within 9 months of registration. The research proposal consists of **no more than 6 single spaced typewritten pages including figures and references**. It must contain:
  - a) A short abstract of no more than 150 words
  - b) A clear explanation of the research problem and thesis objectives
  - c) A brief review of the critical literature relevant to the project
  - d) An outline of the research methodology
  - e) A discussion of potential results of the research and their implications
  - f) A timetable of research activities

The proposal must be approved by the PhD Advisory Committee in order to proceed to the PhD Qualifying Examination. The PhD thesis supervisor will forward a copy of the thesis proposal to the Departmental Graduate Coordinator to be filed in the student's personal dossier.

- 2) Full-time and part-time students registered in the PhD program with a MSc degree must pass an oral PhD Qualifying Examination within 12 months and 18 months of registration, respectively. Students transferring from the MSc to PhD program without first completing the MSc program must pass the Qualifying Examination within 12 months of the transfer or within 24 months of first registration in the MSc program, whichever period is longer.
- 3) The PhD Qualifying Examination Board will consist of the PhD Advisory Committee and at least one other member of the Department who will be selected by the PhD Advisory Committee in consultation with the Departmental Graduate Coordinator. The Departmental Graduate Coordinator or a designated alternate will chair the examination.
- 4) Only the PhD Qualifying Examination Board will attend the PhD Qualifying Examination. The student must present a brief oral summary of the research proposal, including details of work to date, work in progress, and a plan for completion. Following the presentation, the student will be asked questions in sub-disciplines of geology relevant to the thesis project. The subdisciplines will be decided by the PhD Advisory Committee and communicated in writing to the student within one week of approval of the PhD Research Proposal. The number of subdisciplines will normally be limited to three, but more than three may be identified by the PhD Advisory Committee if necessitated by the scope of the PhD Research Proposal.
- 5) The PhD Qualifying Examination Board will assign an unconditional pass, a pass with conditions, a fail with the option to retake the examination once within six months, or a fail with dismissal. A simple majority vote, or a split vote if the Board is composed of an even number of voting members, is required for an unconditional pass or a pass with conditions. The conditions may include taking one or more undergraduate or graduate courses and/or studying a list of texts/research papers. The student will be notified of the decision of the Board immediately after the Examination. The Chair of the Board will submit a brief written report of the Examination to the Dean of the School of Graduate Studies with copies to the student, the members of the PhD Qualifying Examination Board, and the Departmental Graduate Coordinator.

## Thesis Guidelines and Regulations

### Introduction

This guide is intended to help both students and supervisors avoid any difficulties in the preparation and presentation of a thesis. The guidelines shown here are for a Ph.D. thesis, but equally apply for a M.Sc. thesis.

### Thesis

A Ph.D. thesis must be a scholarly, research-based contribution containing original material of a high intellectual caliber. This may be presented in the traditional thesis format or as a collection of papers and/or manuscripts, in accordance with the regulations below. In order to achieve additional flexibility it is permissible to include Appendices of data, maps and copies of original computer software/code in digital format. Maps may be submitted in paper and/or digital format as is most appropriate.

Those students who choose to submit a series of papers or manuscripts should include a brief introductory paper/chapter outlining the objectives of the thesis, and indicating how the attached papers and associated digital or non-digital data bases are related to the central theme. Where papers with joint authorship are included *the student must indicate the extent of their contribution*. They are expected to produce letters from co-authors to verify this information.

### Thesis Manuscript

A thesis in *classical format* should include:

- 1) A title page: this should include only the title of the paper, followed by the name of the author, the rationale for submission (i.e. a thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Mineral Deposits and Precambrian Geology at the Department of Earth Science, Laurentian University), and the date of submission.
- 2) A certificate of examination (to be provided after the defense by the School of Graduate Studies) which includes: the title of the thesis; the name of the candidate; the degree awarded; date of defense; department; names and signatures of the thesis examiners and the name and signature of the Director of Graduate Studies or his designated alternate.
- 3) An abstract, which should not exceed 250 words and should be a succinct summary of how and why the work was done, the salient results, their interpretation and broader implications. Students who can submit abstracts in both English and French are encouraged to do so. References should not be cited in the abstract. Abbreviations other than SI units and chemical formulae should be avoided.
- 4) Acknowledgements
- 5) Table of contents
- 6) List of figures
- 7) List of tables
- 8) List of appendices, maps and digital products

The above should be paginated using lower-case Roman numerals, which should be printed on the document after the abstract page. The body of the thesis is numbered in the conventional manner.

- 9) The body of the thesis should contain:
  - a) An **introduction**, providing a general overview of the topic, and the specific thesis objectives.
  - b) **Sections** with topical headings, for example, previous work, geological framework, **new**

**observations**, methodology, geochemistry, economic implications, etc.

- c) A section on **Discussion** or **Interpretation**
- d) Conclusions
- e) References
- f) Acknowledgements
- g) Appendices, maps and digital products

If using more than one order of heading in the body of the thesis, use bold lettering in larger type for first order headings, bold lettering in normal type for second order headings (subsections) and normal *italicized* type for third order headings.

### **Thesis in Non-Traditional Format**

When submitting a series of papers or manuscripts in lieu of a traditional thesis, the student should include a brief introductory paper, modeled on the classical thesis, outlined above (including sections 1 to 4, and 9 to 14 as appropriate). This summary paper should include *a brief introduction outlining the objectives of the thesis, and indicating how the attached papers and associated digital or non-digital databases are related to the central theme*. Where papers with joint authorship are included the student must indicate the extent of their contribution.

Copies of published papers and manuscripts should be in a format acceptable for publication in a national or international peer reviewed journal.

### **General Rules for Manuscripts in all Geology Programs**

The original text of the thesis should be typed or printed, double-spaced 10- or 12 point, on high quality bonded paper, of 8.5” x 11” size. Printing should be on one side only of each sheet. On the left side there should be a margin of 1.5” so that binding will not interfere with the text. There should be 1” margins on the right side, top and bottom.

*Footnotes should be avoided if at all possible.*

Equations and formulae must be set clearly in type and triple spaced. Letters or symbols should represent only one entity and be used consistently throughout the text. Each variable must be defined in the text.

Symbols, units, and nomenclature should conform to international recommendations. Metric (SI) units should be used (as summarized in Canadian Metric Practice Guide 1989 published by the Canadian Standards Association).

Geological nomenclature should follow the usage in the American Geological Institute’s Glossary of Geology (2005) except where superseded by International recommendations. Stratigraphic nomenclature should follow the **North American Stratigraphic code** (American Association of Petroleum Geologists Bulletin 67 (5): 841-875, or ***Stratigraphy.org***). Only formal time-stratigraphic and geological time units should be capitalized. Abbreviations for mineral names should follow R. Kretz, American Mineralogist 68: 277-279. Species and genus names should follow the International Code of Zoological Nomenclature.

Abbreviations and contractions of the names of rock units, procedures etc., must be defined the first time they occur and should be used sparingly. Grammar should follow Fowler’s Modern English Usage.

Spelling should follow that of the latest edition of the Oxford English Dictionary. Students are responsible for consistency in spelling.

Pagination. Lower case Roman numerals must be used for preliminary pages in the classical thesis format, and should appear in the lower right-hand corner of the page. For paper format, and the text of thesis,

Arabic numerals should appear on all pages (except the title page and first page) in the upper right-hand corner of the page, including all references and appendices.

Illustrations (photographic and drawn) should fit in the same margins as text. All illustrations should be numbered in sequence and be referred to accordingly in the text.

### ***Selection of a Board of Examiners***

No later than **seven weeks** before the anticipated date of a thesis defense the graduate (Ph.D. or M.Sc.) coordinator submits a form recommending the members of the Board of Examiners to the Director of the School of Graduate Studies. When the Director has approved the Board of Examiners, the School of Graduate Studies informs the Ph.D. Coordinator and the Supervisor.

For the Ph.D. examination, the program's departmental Ph.D. Coordinator informally invites all members of the examining board (supervisor, two program examiners, university examiner, and external examiner) and establishes a time frame for examination. The School of Graduate Studies then arranges the examination and formally invites members of the Examining Board to serve.

### ***Submission of Thesis for Examination***

A minimum of five paper copies (three for M.Sc.) of the thesis, including all appendices and attachments must be submitted to the Ph.D. coordinator for forwarding to the School of Graduate Studies no later than six weeks before the projected date of the thesis defense. Once a thesis has been officially submitted for examination, no changes can be made until after the defense.

### ***Final Submission of the Examined and Corrected Thesis***

After successful completion of the thesis defense and all the required revisions to the thesis are made, a minimum of three copies of the approved thesis on high quality bond paper must be delivered to the School of Graduate Studies. The University retains all three copies for use. Additional copies for distribution and personal use may be submitted for binding at the expense of the student.

**AS OF 01 JULY 2013 the rules for final submission change**, due to a change in policy at the National Library of Canada. After this date the final copy of the thesis should be presented as text-based portable document files. These can now contain non-text elements such as sound, video, and hypertext links. They will be made available through LUZoneLU, the University Library's digital data repository, and also released to the world-wide web, with priority in many search engines, enabling scholars worldwide to locate, search, and download Laurentian's ETDs.

A digital copy of the final thesis should also be presented to the departmental secretary for archival purposes. If printed copies are required by the candidate, they may be able to arrange this through the School of Graduate Studies, but details of this are as yet (March 15<sup>th</sup> 2013) unclear.

**Thesis defense regulations** (Modified from existing School of Graduate Studies and Research procedures for thesis defense at the Masters level)



**Laurentian University**  
**Université Laurentienne**

## **School of Graduate Studies and Research**

### **Procedures for Thesis Defense**

**NOTE:** Transmittal of the thesis to the School of Graduate Studies for forwarding to the External Examiner, as well as departmental arrangements for defense date, time, place, etc. must be done through the Ph.D. Coordinator for the department. Receipt of documentation from the Coordinator with the appropriate covering documentation is deemed to be confirmation that the department and all faculty concerned are aware of and approve of the transmittal of the thesis for external examination.

**NOTE:** The student should contact the Registrar's Office to make "Application to Graduate". Until this is done, the University cannot officially confer the degree. The application deadline is normally about 4 months prior to Convocation (i.e. early February deadline for June convocation).

#### **General**

- 1) The Supervisor should contact the Ph.D/M.Sc. Coordinator when the student's thesis is deemed ready for external reading.
- 2) Defense dates should normally be arranged with the Director of Graduate Studies and Research by the Graduate Coordinator before thesis is delivered to the Graduate School Office for forwarding to the External Examiner.
- 3) Students should not have any contact with the External Examiner prior to the defense.
- 4) The Ph.D. Coordinator will deliver the required number of copies of the thesis, with the appropriate form duly completed, to the School of Graduate Studies and Research.
- 5) A minimum of **five weeks** is allowed for the External Examiner to read a thesis; therefore, it is usual to schedule defense for at least six weeks after the draft thesis is deposited with the Graduate School Office to allow sufficient time for shipping of thesis, etc.
- 6) The defense must take place at least 4 weeks before Registrar's published deadline for completion of all documentation.
- 7) The final corrected version of the thesis must be submitted to the School of Graduate Studies and Research no later than 2 weeks before Registrar's published deadline.

#### **Defense**

- 1) Once a date is agreed on by Graduate Studies and department, the Graduate Coordinator must ensure that a proper location for the defense is booked and that any special equipment, such as teleconferencing equipment or overhead projectors, etc., is arranged if necessary.
- 2) Announcements of the defense must be posted throughout the university at least seven days in advance of the defense. Failure to do so can result in the delay of the defense.

### **Teaching Assistantships**

TAs, where awarded allow for up to 10 hrs per week demonstrating, which must follow the guideline provided in the current agreement between the university and the graduates student association. If you are asked to work beyond the 5hr limit, per 3 credit course, you may refuse to do this. You are not expected to mark lab assignments for which an answer key is not provided. Students may not be expected to mark final exams. If you have problems with any of the above contact the Graduate Secretary of the Department of Earth Sciences for further clarification.

## Graduate School Report on Progress Towards Master's or PhD Degree

Name:

Year in Program:

Program:

Members of the supervisory committee:

### To be completed by student

1. What progress have you made toward your degree during the past year? (Do not include progress recorded in last year's report.) Please explain deviations from last year's goals.
2. Please itemize the remaining requirements for your degree, including stages of your thesis or dissertation and propose a timetable for completing them, with specific goals for the next year:

### To be completed by supervisor

1. Comments on the student's progress during the last year:
2. Comments on the student's objectives for next year:
3. Comments on student's timetable for completing degree requirements, including thesis or dissertation:
4. Considering the overall professional development of the student (e.g. stage in program, conference presentations, publications, etc.), is he/she making satisfactory academic progress? If not, explain why.
5. At least two members of the supervisory committee met with this student to discuss his/her progress.

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Supervisor's Signature

Date

6. Student's reply to the committee's comments:

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Student's Signature

Date

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Coordinator's Signature

Date

A copy of this report will be forwarded by the Coordinator to the Dean of the School of Graduate Studies and Research.

## Department Report on Progress Towards Master’s or PhD Degree

<b>Student:</b>	<b>Current Date:</b>
<b>BSc</b>	<b>MSc</b>
<b>Date Admitted:</b>	<b>Supervisor(s):</b>
<b>Address:</b>	<b>Committee:</b>
<b>Tel:</b>	
<b>Email:</b>	
<b>Expected Completion Date</b>	<b>Degree MSc Applied MSc PhD</b>
<b>Sponsors:</b>	<b>Funding Sources:</b>
<b>Thesis/Project Title:</b>	
<b>Required Tasks</b>	<b>Courses Taken/Term(s)/Mark(s)</b>
<b>Thesis Proposal (MSc/PhD) Date Completed</b>	
<b>Project Plan (Applied MSc) Date Completed</b>	
<b>Qualifying Exam (PhD) Date Completed</b>	
<b>Defence (MSc/PhD) Date Completed</b>	
<b>Past Committee Meetings</b>	
<b>Tasks Completed This Term/Year</b>	
<b>Tasks Not Completed and Reasons</b>	
<b>Work Planned for Next Term/Year</b>	
<b>Comments on Project Status/Action Items</b>	
<b>Supervisor(s)/Committee Comments on Student Progress</b>	
(SIGN AND DATE)	
<i>Student:</i>	
<i>Supervisor(s):</i>	
<i>Graduate Coordinator:</i>	
<b>Attachments:</b>	