

GEOLOGICAL SCIENCES AND GEOLOGICAL ENGINEERING

Departmental Facilities

The department is located in stately Miller Hall and its modern Bruce Wing. There are excellent study collections, including more than 70,000 volumes and 20,000 maps housed in the university's Douglas Library. We are also proud of our superb mineralogical, petrological, sedimentological and paleontological collections.

In addition to the standard tools related to the Earth Sciences, the department is home to numerous high-end laboratory and computational facilities. Among these facilities are the following:

- A new electron microprobe and scanning electronic microscope with mineral analyser facilities for the determination of the chemical composition of micron-scale areas on mineral samples. Training courses are regularly provided for interested graduate students.
- X-ray diffraction facilities that include a new Xpert Pro Philips powder diffractometer with an X'celerator area detector and 15-sample chamber magazine. The diffractometer is equipped with an environmental chamber which allows diffraction experiments under a wide range of pressures and temperatures.
- Fluid inclusion facilities including two new Linkham cooling-heating stages and digital imaging, allowing for investigation of fluid inclusion at temperatures between 180°C and 1500°C.
- The Queen's University 40Ar/39Ar geochronology laboratory contains an 8 W Ar-ion laser and Modifications Inc. resistance furnace coupled to an MAP 216 mass spectrometer, yielding 40Ar/39Ar ages with typical precisions of $\pm 0.5\%$. The laser can be used in both spot-dating and step-heating modes to maximise the isotopic age information from the samples.
- The department is home to the Queen's Facility for Isotope Research (www.queensu.ca/geol/qfir/facilities/qfir-stable-isotope-lab (<http://www.queensu.ca/geol/qfir/facilities/qfir-stable-isotope-lab/>)), an ultra-modern and diverse geochemical laboratory capable of analysing the isotopic composition of a wide range of elements in almost any material. The equipment includes a MAT 252 Delta XP and a new MAT 253 isotope ratio mass spectrometers plus a full suite of peripheral tools such as gas chromatographs, elemental analyzers and a gas bench. There are also two complementary Inductive Coupled Plasma Spectrometer (ICPMS) systems, complete with two inniegan Elements, ICPOES, a Thermo X and a Finnegan Neptune multicollector. All can be interfaced with our 193, 213 or femtosecond laser systems for ablation to analyze trace element compositions on a scale of 10 micrometers.
- The Rose Geocomputation Laboratory in the Department of Geological Sciences and Geological Engineering provides computational resources. The lab is equipped with 6 PC workstations with GIS, CAD, programming, and geological modeling software. Network file servers allow data and project work to be shared and seamlessly moved between work locations. Funded by a generous donation from Mike and Sue Rose, alumni of the Department, the Lab has continuing funding to remain state-of-the-art for future generations of students.
- A 20,000g centrifuge is available for experimental tectonic modelling. This facility is unique in Canada, and, to the best of our knowledge, is one of only three in the world that are used for scaled modelling of tectonic processes.
- There is a state of the art Geomechanics Computation Laboratory with research and design analysis software including comprehensive packages from RocScience, Mine Modelling, Itasca and others. This suite of analysis tools is used for engineering design analysis and can also be applied to geomechanical analysis of earth processes. There is also a new and complementary laboratory-scale multi-channel full-waveform acoustic emission system from ESG Inc., intended for use with conventional rock-testing apparatus.
- The Earth Systems Information Laboratory is the teaching computing lab for the Department of Geological Sciences and Geological Engineering. With 50+ computers, screen projection for presentations or software demonstrations, access to network file servers, and scanning and printing facilities, the Lab can handle full lab classes as needed. Geophysical, geological, GIS and CAD software are available for student use on all computers.
- Microstructural Laboratory: The microstructural laboratory consists of two high-end petrographic microscopes (Leica M420 macroscope with high-quality 6:1 Apozoom objective, and a Nikon E600 polarizing microscope up to 100x), both linked to a QIcam 12bit monochrome high resolution digital camera operated by a Compix Image processing and Analysis (IPA) software. This software can isolate mineral populations, and perform several quantitative measurement tasks on captured images. The laboratory also has a standard Leitz petrographic microscope equipped with a 5-axis Leitz



Universal stage for crystallographic preferred orientation measurements.

Financial Assistance

The Department of Geological Sciences and Geological Engineering guarantees minimum stipends for its funding-eligible students. The minimum for students completing a master's two year research program is \$21,000 per annum. For Ph.D. students the minimum is \$23,000. Both minimum stipends are effective as long as the student is within terms of support. Actual financial support may be higher in many cases, depending on external awards student may have received. The one-year master's students receive no financial assistance.

Fields of Graduate Study and Research

Research in the Department of Geological Sciences and Geological Engineering is offered in five fields of study.

- Field I - Economic Geology and Mineral Exploration
- Field II - Petrology and Structural Geology
- Field III - Sedimentology, Sedimentary Geochemistry and Paleobiology
- Field IV - Geophysics and Geochronology
- Field V - Applied Geoenvironmental Sciences and Geotechnique

The Department provides opportunities for a broad range of major subfields in the earth sciences, including mineralogy, petrology, structural geology, stratigraphy, sedimentology, paleontology, geochemistry, geophysics, environmental and economic geology. In geological engineering there are particular strengths covering hydrogeology, environmental geochemistry, geomechanics, hazard mitigation and earth-structure interaction.

Members of the department's staff often collaborate, giving graduate students exciting opportunities for multidisciplinary research under co-supervision.

Among the broad areas in which recent graduate research projects have been concentrated are: integrated geochronological and metallogenic studies of parts of the Canadian Shield and the Cordillera of North and South America, genesis of mineral deposits in all geological settings and their application to exploration models, tectonics of the Canadian Cordillera and the Canadian Shield, environmental studies in the Canadian arctic as well as other parts of North America, integrated sedimentological/geochemical/paleobiological studies of modern and ancient carbonate and siliciclastic depositional systems, the early evolution of

animals and their ecosystems, exploration geochemistry, and theoretical to observational studies in both exploration and earthquake seismology. Geological Engineering projects have focussed on fundamental properties of hydrostratigraphic units, analysis and design protocols for tunnelling near surface and at great depth, stability of large natural and cut slopes, and geomechanical risk assessment for mining.

The Master of Science in Applied Geology (Non-Research Pattern II and III)

The Master of Science in Applied Geology is a one-year program leading to enhanced knowledge in Mineral Exploration/Resource Geology or Geological Engineering.

Students interested in engineering geology may also wish to investigate the GeoEngineering Centre (www.geoeng.ca) (<http://www.geoeng.ca/>), a collaboration with the Queen's Civil and Mining Engineering departments and with the Royal Military College.