Welcome to...

Queen’s

Geological Engineering

Orientation Night

CLASS OF 2019

Dr. Georgia Fotopoulos, PEng
GEOENG Undergrad Advisor

Department of Geological Sciences and Geological Engineering

Miller Hall
What is Geological Engineering?

Geological Engineering is the practical application of the principles, concepts and techniques of the geological sciences to human needs.

A Geological Engineer combines:

- a knowledge of geological materials
- and earth engineering design principles

...to create viable and sustainable projects
Geological Engineering and Sustainable Development

“development that satisfies present needs without compromising the needs of the future”

GEOlological Engineering Prepares You for Many Career Paths and Job Opportunities…
Dr. Mark Diederichs, PEng
GEO-Expertise for Oil and Gas (incl Geophys)

GEO-Technical Rock & Soil Engineering
GEO-Hazard Management

Office? Only if you want one!
Preparing You For the World
Queen’s Undergrads and Grad Students Working Everywhere

Why Geological Engineering at Queens?

Well rounded education and skill set and confidence to go beyond …….
Jenn Day – Sci’11
My Geological Engineering Adventure
(so far…)

Why I took Geo…
(and never looked back!)

2nd year Field Experience
After 2\textsuperscript{nd} year: Field Mapping - Geological Survey of Canada

BAFFIN ISLAND

Why I took Geo… (and never looked back!)

3\textsuperscript{rd} and 4\textsuperscript{th} year

1. Learn geological principles
2. Test rocks for engineering properties
3. Combine knowledge for design!

1. 
2. 
3.
After 3\textsuperscript{rd} year: Consulting - BGC Engineering

Geotechnical and Environmental Engineering

After 4\textsuperscript{th} year:

Geologist – Barkerville Gold Mines

Investigating rock for gold exploration

Rock Mechanics - MDENG

Investigating rock for mine construction and safety
Grad School =
Focussed Courses +
Exciting Research +
Hi Tech Tools
(Lab, Field, Software)
+ Travel……
Canada, Switzerland,
France, Italy,
Greece, Austria,
Germany, Chile,
Brazil, USA……

After some great jobs………

16.7m Diameter
Tunnel Boring Machine
SPARVO, ITALY
This would EAT Miller Hall!
My Geo-Adventures so far:

TOPICS...
Mineral Exploration
Environmental Engineering
Underground Rock Mechanics
Mining Soil Mechanics
3D Laser Modelling
Pit Slope Stability
Deep Tunnelling and
Nuclear Waste Storage
Can't wait to see what's next!

Mark Diederichs, PEng, GeolEng Chair

The Program

MATH
GEOLOGY
CHEMISTRY
MECHANICS
PHYSICS
ECONOMICS
APPLIED SCIENCE
ENGINEERING ANALYSIS
DESIGN
4th Year
GEO-ENG DESIGN
Queens Geological Engineering Program

INVESTIGATION AND MEASUREMENT

CREATIVITY
TEAMWORK

DESIGN of Geological Models

JUDGEMENT

ANALYSIS

DESIGN of Engineered Solutions

DESIGN of Analysis Protocols

Scott McTavish - Class of 2016
ENGINEERING GEOLOGY FOR MINERAL EXPLORATION

Madeleine Sauve
Class of 2017
Scott McTavish
Class of 2016

Exploration and Engineering Geology
Exploration Geology
Field Mapping with the Ontario Geological Survey
Madeleine Sauve  Sci 17
Geoscience and Engineering Labs
Dr. Kurt Kyser
Queen’s Facility for Isotope Research (QFIR)

Physical and chemical approaches to understanding the earth using the most advanced technologies

Research + Teaching + Student Projects

Queen’s Facility for Isotope Research (QFIR) Lab
$8 million very hi-tech lab
Dedicated to doing CSI on all natural systems!

Extraction line for oxygen in rocks and minerals
selfFrag - high voltage pulse fragmentor

inductively-coupled plasma for element and isotopic analysis
Our Philosophy: Hands On Training In all Labs

Learning to identify minerals using microscopes: 2nd and 3rd year geomaterials

Determining the structure of materials using X-Ray Diffraction
2nd and 3rd year structural design

Electron microbeam techniques
Composition of Earth materials at all levels
3rd / 4th year projects

Environmental Scanning Electron Microscope

Electron Microprobe
Timing is everything in Earth science
From Yesterday to 4 Billion Years Ago – we can tell

• **Dating rocks and minerals using laser** – 4th year projects

Zircon grain: U-Pb and Pb-Pb ICP-MS

Laser Ablation
Microscale chemistry of complex materials
4th year projects

Femto Second Laser Ablation System

Undergraduate Projects in the Geochemistry Lab

Find and remediate ore deposits:
*Sustain standard of living with minimal environmental impact*

Isotopes in rocks, minerals, gases, water, organic matter
*How do earth systems work?*

Timing of events recorded in rocks:
*What is the history of the Earth?*

Changing environmental patterns:
*How are humans affecting the environment and how components move from the geosphere into the biosphere*
FIELD EDUCATION
Ellen Handyside Sci ’17
and Callum Walter Sci ‘16

FIELD SCHOOL
Colouuring intensifies
Ellen Handyside
Sci ’17
work hard
Fourth Year Engineering Field Education
Callum Walter Sci ‘16

Fourth Year Field School
Northern Ontario Mine Sites
Production, Ground Control and Environmental

Underground Rock Engineering
Fourth Year Field School

Big Nickel

Open Pit Mine Stability

Tailings Facility Engineering

GEOE 413
Engineering Geology and Rock Engineering

How to determine the mechanical properties of nature for engineering design?
Scans and Analysis for Underground Rock Engineering

Computational Geomechanics: 2-D, 3-D Geotechnical Analysis
Rockfalls and Game Engines?

Rockfall Simulation
Experiences in Energy Resource Engineering
Simone Markus and Miranda Sametz

Simone Markus, Sci 17
Geotechnical Engineering Intern at Shell Canada

Oil Sands Mine
Fort McMurray, Alberta
Slope stability, water pressure monitoring, mine and tailings inspections
Simone Markus, Sci 17

Slope stability, water pressure monitoring, mine and tailings inspections

Working in Oil and Gas
→ Travel!
→ Friends!
→ Fun!
Miranda Sametz
4th Year Geological Engineering
Oil and Gas

- Production operator
- Conventional heavy oil

- Injections student
- Enhanced CO₂ oil recovery

- Consulting company
- Oil facilities design

- Consulting company
- Oil facilities design

- Calgary, Alberta
  - Consulting company
  - Oil facilities design
Summer work with Cenovus Energy offers a valuable experience to students.

Weyburn, Saskatchewan
- Injections student
- Enhanced CO₂ oil recovery

Lloydminster, Alberta/Saskatchewan
- Production operator
- Conventional heavy oil

Lloydminster, Alberta/Saskatchewan
- Production operator
- Conventional heavy oil

Making work friends
Rock-Fall Analysis

Energy (kJ) vs Time (s)

Velocity (m/s) vs Time (s)
Your Career in Geophysics and Engineering

Dr. Alexander Braun

• 249 Geophysical Characterization of the Earth

• 319 - Applied Geophysics

• 419 - Geophysics Field School (Renfrew, 10 days)

• 439 - Advanced Applied Geophysics

• Some special studies courses, Exploration Seismology, Imperial Oil Barrel Competition

Your Career in Geophysics and Engineering
Geophysics: Equipment, Software and Toys

Geophysics software donations for student use valued at $196 million.

Remote Sensing by UAV (x3)

Resistivity/IP Survey

Ground Penetrating Radar

Electromagnetics

Magnetometry

Seismic Survey
Why do Geophysics?

Mineral Exploration
Geotechnical
Environmental
Oil and gas
Archaeology
Space
IT

Dynamis Graphics Inc

Explore, Understand and Engineer our Planet from Global to Nano Scales...

Geophysics@Queens welcomes you to …

..and have the time of your life!

Chen et al., 2012
Natalie Blacklock  Sci ‘15
Geophysics Field School
Renfrew, ON

Geophysics in Exploration
Canadian Malartic Mine, QC

Canadian Malartic Mine, QC
Geophysics in Deep Mining
Glencore Sudbury, ON

The 3 R’s of Queen’s Geological Engineering

Reputation
Sought after by Industry
Salaries Start at $50K to $100K
Queen’s is one of Top 2 Geo-Schools in the country (Maclean’s)

Responsibility
Student involvement in all aspects of the department

Recognition
Leads to PENG License
+ can also lead to PGEO

Georgia Fotopoulos, PEng
One More R

RELEVANCE

4th Year Design Projects:

Meeting Industry and Public Needs

Site Investigation Design
Geological Model Design

Analysis Program Design
Final Project Design

GEO-ENG DESIGN

INVESTIGATION AND MEASUREMENT

CREATIVITY

TEAWORK

DESIGN of Geological Models

DESIGN of Engineered Solutions

JUDGEMENT

ANALYSIS

Queens Geological Engineering Program
Summer in the Department
Eleanor McAuley and Katie Irwin

Field Work

Eleanor McAuley Sci ’17
BISC British Archeology Field School

Geophysics Summer Research

Project SPACE BEAVER
Second Year Geo

Why We Chose Geo

- Love for the Outdoors
- Passion for the Environment
- Everything Starts With the Earth

Presented By:
Connor Meeks
Olivia Wojcieszynski

Field Methods
Intro to GeoEng (GeoE281)

Field Trip

Kingston Harbour in the 1920s

Family Field Fun

Help is Always Near!

Small Class Size
Friendly Upper Years
Amazing Professors
The Miller Club
Undergraduate Society for Geological Sciences and Geological Engineers

Fun

Students

Jess Andrew (Sci ‘16) President

Academics

Teams

Sports!!!!
What Else We Do...

For the Department:

• Curriculum Committee
• Promotion and Tenure Committee
• BED Fund Representative
• Alumni & Industry Reps

For the Students:

• Bus to PDAC
• Geo-Help Centre
• Beers with Profs
• Networking/Resume Workshops
• 4th Year Dinner
• Engineering Wine and Cheese
• And MANY more!

Dr. Mark Diederichs

Alumni and Careers

Geological Engineering at Queen's is a well-established, highly regarded, thriving and dynamic program with a long tradition of excellence.

We take great pride in our strong alumni presence in Canadian and international industry and across the R&D spectrum.

Here is just a sample.....
Marlène Villeneuve
GEO BSc Eng 2002  GEO PhD 2008

3 yrs Tunnelling Engineer
California and Australia

Now: Professor Engineering
Geology, New Zealand

Tunnelling with a 10m Boring Machine
2km under the Swiss Alps (her PhD)

Rick Wasfy
GEO BSc Eng  2004

2011 - Calgary

Tour d’Afrique – 2010 –
Cairo to Cape Town

Lead Engineer
Queen’s Johnson Award Winners

Sue Riddell Rose
GEO BSc Eng 1986

“Investing in Queen’s is truly investing in the future leaders of the 21st century... and that is, no doubt, a high return, compounding investment worth making.”

Drew Feustel
PhD Queen’s Geophysics, 1995

NASA ASTRONAUT MISSION SPECIALIST
**Victoria Sterritt**
GEO BSc Eng 2004

Senior Project Geophysicist for TECK
Masters of Economic Geology, UBC, 2006
MBA, Queen’s 2015
Returned to Teck, ...
.....first week back !

**Geoffrey Ballard**
B.Sc.Eng, 1956

Inventor of the Ballard hydrogen fuel cell
One of MacLean’s magazine’s 50 Canadians to watch in 2003

Geological Engineering was important to my success because:

It taught me to make good decisions based on fragmentary and scattered data - A highly prized ability in business.