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Faculty of Science Course Syllabus
Department of Earth Sciences
ERTH2380
Geochemistry
Winter Semester 2023

Instructor(s):	*Richard Cox*	*richard.cox@dal.ca*	*LSC (Oceanography wing - Room 4626)*
Lectures:	*Tue and Thurs*	*1:05 PM – 2:25 PM*	*Location: LSC - EES wing - Room 2030*
Laboratories:	*N/A*		
Tutorials:	*Fri*	*11:25 AM - 1:35 PM*	*Location: LSC - EES wing - Room 2030*

Course Description

An introduction to the principle of chemistry applied to geologic systems, including overviews of the chemistry of rocks and minerals, isotopes in the geologic environment, processes that control the speciation and mobility of elements in different geological environments, and the use of geochemical data in solving geologic and environmental problems.

Course Prerequisites

ERTH2001 & CHEM 1011/CHEM 1012 or equivalent, or permission of the instructor.

Course Objectives/Learning Outcomes

Why Geochemistry? The study of the distribution of elements and chemical fluxes in the earth is known as geochemistry. This branch of the geosciences forms the basis of understanding for many geological processes. A background in geochemistry will provide the foundation for understanding many of the concepts in igneous, metamorphic and sedimentary petrology, economic geology, environmental sciences and hydrogeology. Geochemical analysis and modeling allows geoscientists to understand processes which occur in every planetary environment from magma formation and crystallization in the deep earth, to weathering and biogeochemical cycling of elements on the planet's surface and atmosphere. In other words, a basic understanding of the nature of geochemistry is essential for any geoscientist.

The overall goal for this course: To describe the periodic table in terms of the Earth and specific geosystems; to analyze and present geochemical data in a meaningful and informative way; to use common software programs to analyze, evaluate and present geochemical data to others through both reports and a presentation and abstract; to critically interpret geochemical data and to model and describe what the data is telling us about earth systems and processes.

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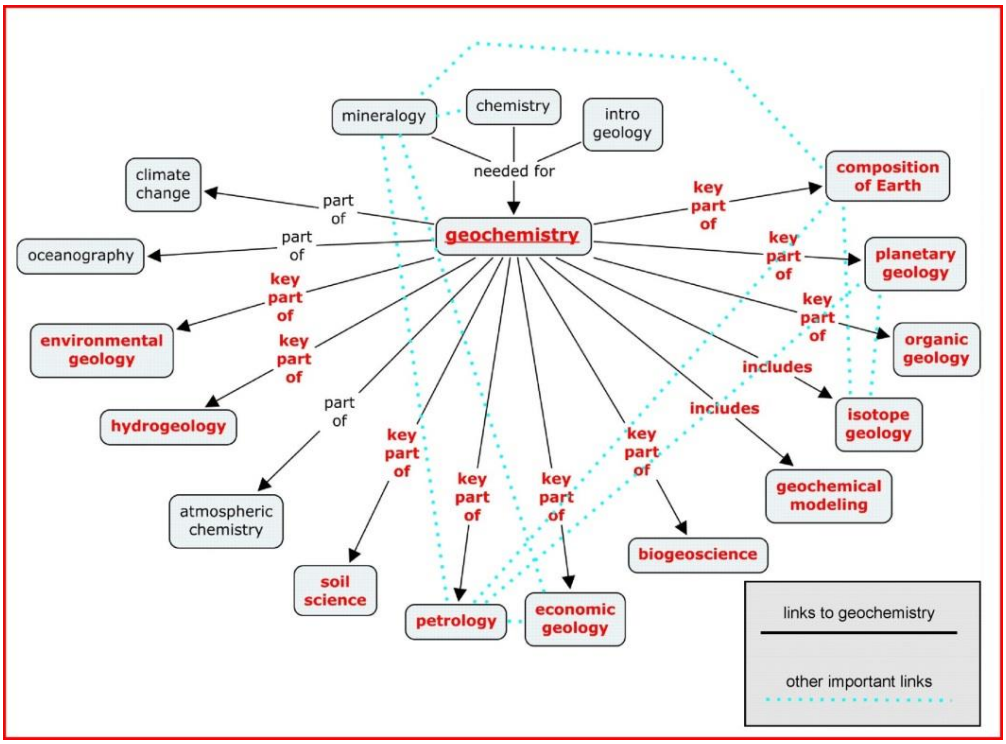

A consensus view of where geochemistry lies within Earth systems and processes (from: https://d32ogoqmya1dw8.cloudfront.net/images/NAGTWorkshops/geochemistry10/geochemistry_centric_world.jpg)

Course Materials

Required Textbook:

Hugh Rollinson and Victoria Pease ***"Using Geochemical Data to Understand Geological Processes"*** 2nd edition. *ISBN 978-1-108-74584-0*

This book is strongly recommended for ***all*** *petrology courses and the 1st edition was widely used by geoscientists as a reference book. The second edition is even better!*

Other materials required:

Other material will be posted on Brightspace.

Course Outline

Part 1: Geochemical Funamentals and Analytical Methods

What is geochemistry? - Nomenclature, terms and broad applications, analytical methods
Understanding the Periodic Table (basic review of chemistry) - The geochemist's Periodic Table
*How do we get at the information we need? - Sampling, sample preparation, analytical methods
*Reporting Geochemical Data - Detection limits, errors, precision, accuracy, using common programs
The general distribution of elements in geochemical systems
The distribution co-efficient, modeling processes
What makes things tick/tock? (Reactions, Thermodynamics, Kinetics, Diffusion)

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* *For PGeo certifications these are particularly important*

Part 2: Geochemical systems, reservoirs and fluxes including case studies and applications

Distribution of elements in the "solid" Earth and other planetary bodies

- **Major Elements* in the lithosphere (core, mantle, oceanic crust, continental crust)
- **Trace Elements* in the lithosphere (REE, HFSE, Alkali elements, etc)

Isotope geochemistry

- *Radiogenic isotopes* (Rb-Sr, Sm-Nd, (U-Th-Pb) - including *geochronology* (absolute age dating) using *U-Th-Pb, *fission track dating, *U-Th-He, and when time allows U-Th disequilibrium dating, and K-Ar (Ar-Ar)).
-*Stable Isotopes* (*$^{18}O/^{16}O$, *D/H, *$^{13}C/^{12}C$, *$^{32}S/^{34}S$)

* Note: We have research labs which carry out these analyses here at Dalhousie.

Part 3: Using and presenting geochemical data (this is where you will "take over")

Assessing the "correctness" of data - standards, variations, etc.

Presenting geochemical data

- *Normalization, plotting, ratios, etc.*
- *Making appropriate descriptions of the results*
- *Interpretation* (geochemical classifications, petrotectonic significance, mineral growth rates, reactions, PT-conditions, ages, paleoenvironmental changes, etc., etc.)

* Writing-up *reports* and giving *presentations*
* Just to emphasize *For PGeo certifications these are particularly important*

Course Assessment

Class Plotting Exercises *(8 in total = 5% each =* ***40%*** *of your final mark)*
Plotting exercises 1, 2, 3 and 4 = Using major Elements and trace Element data = 20%.
Plotting Exercises 5, 6, 7 and 8 = Isotopes, geochronology, geochemical reservoirs and fluxes = 20%.

Researching and presenting geochemical data – Term research project *(**25%** of your final mark)*
Progress marks: This involves submission of small parts of the project (e.g. keywords, a main diagram, an intro slide and a conclusion slide) throughout the semester = 5% in total.
Extended abstract: To be submitted before the presentations = 10%.
Class presentations: Will be held in a mini conference during the final class time slots = 10%.

NOTE: This section of the course will also be partly peer reviewed by students in the class who are carrying out research for their own project within a related field. See the course policy related to this below.

Final Exam *(scheduled by the registrar by Feb 1st and will be held between the 13th and the 25th of April)*
3 hour written exam (closed book) **= 35%** of your final mark.

NOTE: The tutorial exercises are not marked BUT questions from these exercises will account for up to **15%** of your final mark, i.e., 15% of the 35% assigned to the final exam. The other part of the final exam

will be based on an applied geochemistry problem(s) similar to the plotting exercises and account for the remaining 20%. The final exam = **35%** of your final mark in total.

Other course requirements

N/A

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	**B+** (77-79)	**C+** (65-69)	**D** (50-54)
A (85-89)	**B** (73-76)	**C** (60-64)	**F** (<50)
A- (80-84)	**B-** (70-72)	**C-** (55-59)	

Course Policies

Lectures will be on campus and we will also hold on-line sessions as required. Attendance at the lectures and tutorials is mandatory. All assignments / exercises handed in late without reasonable and documented cause will be deducted 10% after the deadline and a further 10% per day. Assignments handed in more than 5 days late will not be graded. **IMPORTANT: As the term project will be in part peer review by your fellow students, you MUST attend the mini-conference at the end of the semester whether presenting or not. If you do not attend, you will be deducted 10% of your final mark. If you are reviewing a fellow student's project and you also do not attend their presentation, you will lose 50% of your own project mark.**

ACCOMMODATION POLICY FOR STUDENTS

Students may request accommodation as a result of barriers related to disability, religious obligation, or any characteristic protected under Canadian Human Rights legislation. The full text of Dalhousie's Student Accommodation Policy can be accessed here: http://www.dal.ca/dept/university_secretariat/policies/academic/student-accommodation-policy-wef-sep--1--2014.html

Students who require accommodation for classroom participation or the writing of tests and exams should make their request to the **Advising and Access Services Centre (AASC)** prior to or at the outset of the regular academic year. More information and the ***Request for Accommodation*** form are available at www.dal.ca/access.

ACADEMIC INTEGRITY

Academic integrity, with its embodied values, is seen as a foundation of Dalhousie University. It is the responsibility of all students to be familiar with behaviours and practices associated with academic integrity. Instructors are required to forward any suspected cases of plagiarism or other forms of academic cheating to the Academic Integrity Officer for their Faculty.

The Academic Integrity website (http://academicintegrity.dal.ca) provides students and faculty with information on plagiarism and other forms of academic dishonesty, and has resources to help students succeed honestly. The full text of Dalhousie's ***Policy on Intellectual Honesty*** and ***Faculty Discipline Procedures*** is available here:

http://www.dal.ca/dept/university_secretariat/academic-integrity/academic-policies.html

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STUDENT CODE OF CONDUCT

Dalhousie University has a student code of conduct, and it is expected that students will adhere to the code during their participation in lectures and other activities associated with this course. In general:

"The University treats students as adults free to organize their own personal lives, behaviour and associations subject only to the law, and to University regulations that are necessary to protect

- the integrity and proper functioning of the academic and non – academic programs and activities of the University or its faculties, schools or departments;
- the peaceful and safe enjoyment of University facilities by other members of the University and the public;
- the freedom of members of the University to participate reasonably in the programs of the University and in activities on the University's premises;
- the property of the University or its members."

The full text of the code can be found here:
http://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

COPYRIGHT

All members of the Dalhousie community are expected to comply with their obligations under Canadian copyright law. Dalhousie copyright policies and guidelines, including our Fair Dealing Guidelines, are available at http://www.dal.ca/dept/copyrightoffice.html. Copyright questions should be directed to the Copyright Office at copyright.office@dal.ca.

SERVICES AVAILABLE TO STUDENTS

The following campus services are available to help students develop skills in library research, scientific writing, and effective study habits. The services are available to all Dalhousie students and, unless noted otherwise, are free.

Service	Support Provided	Location	Contact
General Academic Advising	Help with - understanding degree requirements and academic regulations - choosing your major - achieving your educational or career goals - dealing with academic or other difficulties	**Killam Library Ground floor** Rm G28 ***Bissett Centre for Academic Success***	In person: Killam Library Rm G28 By appointment: - e-mail: advising@dal.ca - Phone: (902) 494-3077 - Book online through MyDal

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Dalhousie Libraries	Help to find books and articles for assignments Help with citing sources in the text of your paper and preparation of bibliography	**Killam Library Ground floor** Librarian offices	In person: Service Point (Ground floor) By appointment: Identify your subject librarian (URL below) and contact by email or phone to arrange a time: http://dal.beta.libguides.com/sb.php?subject_id=34328
Studying for Success (SFS)	Help to develop essential study skills through small group workshops or one-on-one coaching sessions Match to a tutor for help in course-specific content (for a reasonable fee)	**Killam Library 3rd floor** Coordinator Rm 3104 Study Coaches Rm 3103	To make an appointment: - Visit main office (Killam Library main floor, Rm G28) - Call (902) 494-3077 - email Coordinator at: sfs@dal.ca or - Simply drop in to see us during posted office hours **All information can be found on our website: www.dal.ca/sfs**
Writing Centre	Meet with coach/tutor to discuss writing assignments (e.g., lab report, research paper, thesis, poster) - Learn to integrate source material into your own work appropriately - Learn about disciplinary writing from a peer or staff member in your field	**Killam Library Ground floor** Learning Commons & Rm G25	To make an appointment: - Visit the Centre (Rm G25) and book an appointment - Call (902) 494-1963 - email writingcentre@dal.ca - Book online through MyDal We are open six days a week **See our website: writingcentre.dal.ca**