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Faculty of Science Course Syllabus
Department of Earth Sciences
ERTH2001
Mineralogy
Fall Semester 2019

Instructor(s): *Richard Cox (richard.cox@dal.ca)*

Lectures: *3 per week (Mon, Wed and Fri - 10:35-11:25 AM)*

Location: LSC common area (Room C216)

Laboratories: *10 labs (Mon and Tue – 2:35-5:25 PM)* *Location: Room LSC 2020A*

Tutorials: *N/A*

Course Description

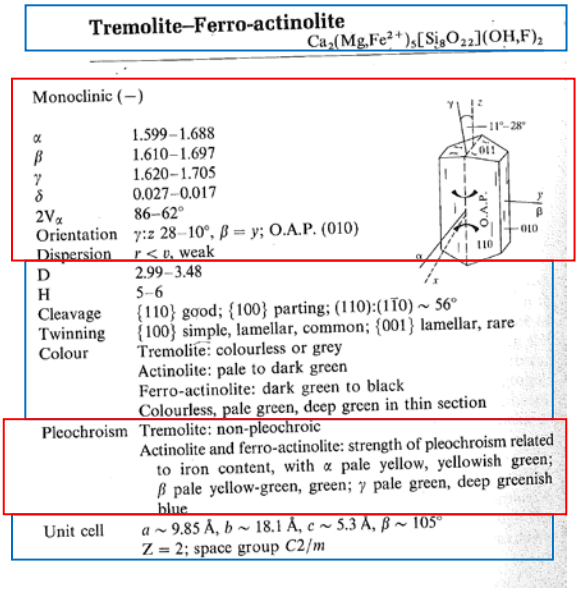
This course introduces description and analysis of minerals, along with their paragenesis. Labs include crystal chemistry, crystallography and optical mineralogy. Key hand specimens and thin sections are used to reinforce systematic mineralogy using a logbook which is updated throughout the semester. X-ray diffraction and electron microprobe methods are also introduced.

Course Prerequisites

ERTH1080, CHEM1011/CHEM1012 or CHEM1021/CHEM1022

Course Objectives/Learning Outcomes

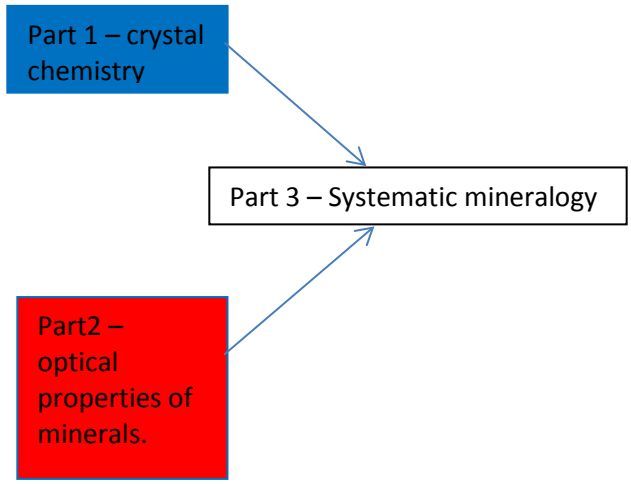
The overall goal for this course: To enable you to use any source of mineralogical information and understand what the all the information presented actually means, how the various parameters are linked, and how to produce and present this data yourself, ***even if*** you have never looked at that mineral before.



Tremolite–Ferro-actinolite
$Ca_2(Mg,Fe^{2+})_5[Si_8O_{22}](OH,F)_2$

Monoclinic (−)

α	1.599–1.688
β	1.610–1.697
γ	1.620–1.705
δ	0.027–0.017
$2V_\alpha$	86–62°
Orientation	γ:z 28–10°, β = y; O.A.P. (010)
Dispersion	r < v, weak
D	2.99–3.48
H	5–6
Cleavage	{110} good; {100} parting; (110):(1$\bar{1}$0) ~ 56°
Twinning	{100} simple, lamellar, common; {001} lamellar, rare
Colour	Tremolite: colourless or grey Actinolite: pale to dark green Ferro-actinolite: dark green to black Colourless, pale green, deep green in thin section
Pleochroism	Tremolite: non-pleochroic Actinolite and ferro-actinolite: strength of pleochroism related to iron content, with α pale yellow, yellowish green; β pale yellow-green, green; γ pale green, deep greenish blue
Unit cell	a ~ 9.85 Å, b ~ 18.1 Å, c ~ 5.3 Å, β ~ 105° Z = 2; space group C2/m



A typical mineral data entry from Deer, Howie and Zussman, (2nd edition) p. 242.

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Minerals are the building blocks of our planet. Having an understanding what they are and how to classify them is therefore essential for every geoscientist.

What is a mineral? ***Mineral:*** *A naturally occurring inorganic element or compound having orderly internal structure and characteristic chemical composition, crystal form, and physical properties.*

1) Chemical formula
2) Structure
3) Crystallinity

These properties are all reproducible from atomic levels to single building blocks (molecules), to single mineralogical unit (unit cell) to the macro scale.

1) How do you describe a mineral? The concepts and skills required:
    - **Physical Properties** (how to do this properly for a **full range** of physical properties)
    - **Crystal Chemistry** (Crystallography, XRD, Electron Microprobe)
    - **Optical Properties** (using the polarizing microscope)
2) Why bother?
    - Is anatomy a new science and has the human body really changed since medicine became a modern field of study? Would you trust a physician that had failed their basic anatomy class? Mineralogy is the equivalent of anatomy in the geosciences.
3) Where is mineralogy applied?
    - Petrology – minerals in rocks, the history of our planet or indeed other planets as the case may be!
    - Mineral resources – where we get almost all of our raw materials.
    - Environmental monitoring – both recent and ancient changes.
    - Geochemistry – minerals are the reservoirs for the elements within the earth.

Course Materials

Required Textbook:
Ness, William D. ***"Introduction to Mineralogy"*** *(3rd edition) Oxford University Press.*
ISBN 978-0-19-982738-1

Other materials required:
A hand lens with at least x8 magnification.
Other material will be posted on Brightspace.

Course Assessment

Component		Weight (% of final grade)	Date
11 class quizzes	*(2% each. Best 10 will be counted)*	*20%*	*Weekly*
Assignments	*Mineral logbook*	*20%*	*After the final lab exam*
	Mineral analysis project	*15%*	*Due by Nov 1st*

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Final Lab exam	*20%*	*(Scheduled by Registrar)*
Final Written Exam	*25%*	*(Scheduled by Registrar)*

Other course requirements

You must attend weekly labs and attendance will be taken during the semester. A low course grade ***and*** failure to attend the weekly labs will mean that no additional credit assignments, or re-assignment of existing marks, will be considered. You will be expected to use some of the lab time to complete parts of your logbook which forms a major component of the course.

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

Class quizzes missed will not be marked and you will be graded on your best 10 scores. The mid-term project if handed in late without reasonable and documented cause will be deducted 10% after the deadline, a further 10% per day, and if more than 5 days late, will not be graded. You must attend one microprobe analysis session. The sessions will be held after Thanksgiving from the Oct 15^{th}-18^{th}. If you do not attend a microprobe analysis session you will get no data and your mid-term project will not be marked. The logbook forms an integral part of the course and is completed as the semester progressed. You will be allowed to take your completed logbook and textbook into the final lab exam. You will submit your logbook immediately after the final lab exam. If the logbook if handed in late without reasonable and documented cause, you will be deducted 10% after the deadline, a further 10% per day, and if more than 5 days late, the logbook will not be graded. As noted above (in other course requirements) you must attend the weekly labs and attendance will be taken throughout the semester.

Course Content

Lectures will be held in parallel with the labs and will also be divided into three sections.

Part 1: Mineral structures and crystal chemistry - 4 labs covering the following topics:

1) Physical Properties of Minerals.
2) Atomic arrangements, closest packing and unit cells.
3) Crystal Chemistry and the relationship of chemical composition to structure.
4) Crystal systems, crystal growth, form and habit, (Miller Index).
5) Analytical Methods: X-ray crystallography (XRD) and electron microprobe (EMP) analysis of minerals.

In parallel we will be looking at the classification of key minerals and mineral groups (the Dana Classification). This forms the first part of your mineral log book.

Part 2: Optical Mineralogy - 4 labs covering the following topics:

1) The polarizing light microscope
2) The first level of optical properites: Relief, color, pleochroism, textures (form, habit, cleavages, fractures, alterations, zoning, etc.).
3) Isotropic / Aniostropic minerals. Birefringence and extinction angles, length fast / slow.

4) Interference figures – Uniaxial minerals (optical figures, optic signs, w and e rays).
5) Interference figures – Biaxial minerals (optical figures, optic signs, 2V angles, a, b and g, rays, flash figures).

In parallel we will be looking at the optical properties of key minerals and mineral groups. This will form the second part of your logbook.

Part 3: Applied Mineralogy and Introduction to Petrology - 2 labs covering the following topics:
1) Identification of minerals, mineral compositions mineral textures, zoning, etc. in thin section.
2) Petrographic descriptions including basic mineral and rock classifications schemes.

The information from your labs will all go into your log book which you must keep up to date with!

University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.
Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).
Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.
Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness
Statement: http://www.dal.ca/cultureofrespect.html

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca).
Information: https://www.dal.ca/campus_life/communities/indigenous.html

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Important Dates in the Academic Year (including add/drop dates)
https://www.dal.ca/academics/important_dates.html

University Grading Practices
https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Missed or Late Academic Requirements due to Student Absence (policy)
https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html

Student Resources and Support

Advising

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: https://www.dal.ca/faculty/science/current-students/academic-advising.html

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: https://libraries.dal.ca/

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: https://libraries.dal.ca/services/copyright-office.html

Fair Dealing Guidelines https://libraries.dal.ca/services/copyright-office/fair-dealing.html

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness/services-support/student-health-and-wellness.html

Student Advocacy: https://dsu.ca/dsas

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Biosafety: https://www.dal.ca/dept/safety/programs-services/biosafety.html

Chemical Safety: https://www.dal.ca/dept/safety/programs-services/chemical-safety.html

Radiation Safety: https://www.dal.ca/dept/safety/programs-services/radiation-safety.html

Scent-Free Program: https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html

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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
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**