

Professor:

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Prerequisite(s):

Earth Sciences 2200a and Chemistry 1301A/B
2 lecture hours, 3 laboratory hours, 0.5 credit course.

Lectures:

Tuesday & Thursday 11:30 – 12:30 pm in P&AB-117

Lab:

Friday 10:30 – 1:30 in B&GS-0184

Calendar Description

Effects of temperature, pressure and bulk composition on stabilities of minerals in natural geological settings are evaluated using thermodynamic principles. Reaction rates among minerals and fluids, including the effects of natural catalysts and inhibitors, and biotic mediation are addressed. Introduction to the principles of radioisotope and stable isotope geochemistry.

Aims of the course:

Geochemistry is essential to all aspects of modern Earth Science. The first part of the course introduces essential geochemical tools of thermodynamics and kinetics, crystal chemistry, aqueous geochemistry, isotope geochemistry, and trace element geochemistry. The second part of the course takes an inside out look at the Earth from a geochemical perspective and includes topics such as the geochemistry of igneous, metamorphic and sedimentary systems and the application of geochemistry to mineral deposit exploration and environmental geochemistry. During the course, students will be evaluated on these topics via weekly labs, homework assignments, a class report and presentation, a mid-term exam, a final exam, and participation in class.

Required Texts:

William M. White, 2013, Geochemistry
- additional notes will be uploaded to the OWL website

External References

An excellent summary of geochemistry applied to a variety of environments is the Treatise on Geochemistry. Unfortunately our library does not have all of the volumes (it does have some). However you can order these or other material not in our library using RACER (see interlibrary loans: <http://www.lib.uwo.ca/ill>). Another library site you should be familiar with are the search engines notably Georef: select this engine at <http://www.lib.uwo.ca/databases/>

Grading Scheme

- 1) Report & Class Presentation (20%)
- 2) Laboratory Assignments (20%)
- 3) Mid-term Exam (15%)
- 4) Participation (10%)

March 28
Weekly or biweekly
February 14

4) Final Exam (35%) During the exam period

Report & Class Presentation

Students will work in teams of three and each student will cover a different aspect of the topic. The report will consist of a 5 page paper, including text, figures and references, on an important topic in geochemistry based on a recent review in the journal 'Elements'. The report should use the same format as this journal and is due March 28th at the beginning of the lab. The team will make a presentation to the class during the March 28th lab time (5 min each=15 min.) with 5 minutes after the talk for questions & discussion. A list of the topics covered in Elements is given at the end of the syllabus. Alternate topics are permitted with the permission of the instructor.

Laboratory Assignments

Lab assignments will be handed out at the beginning of the lab and the due date will be indicated (weekly or biweekly). Attendance promptly at the beginning of the lab period is mandatory. Laboratories are due at the end of the lab unless otherwise indicated. Make-up labs are only possible by special arrangement made prior to the lab. In case of illness see the information in the university policies below.

Mid-term and final exams

The mid-term exam will be February 14th, one hour in length and held during the laboratory time slot. The final Exam will be scheduled by the Registrar's office during the exam period. For both the mid-term and final exam a calculator and a ruler are needed. Only calculators approved by the University of Western Ontario will be allowed during exams. The mid-term and final exam both follow a mixed format. Questions can include multiple choice, short answer and problems. Material from both the lectures and labs will be tested.

2230b Course Content

1. Introduction
2. Causes of Geochemical Reactions: Laws of Thermodynamics, Entropy, & Enthalpy; Free Energy and Equilibrium; Thermodynamics of Solutions & Equilibrium Constants
3. Aqueous Geochemistry: Properties of Water; Solutions and Solubilities; pH, Eh; Oxidation and Reduction; Acid-Base Reactions; Complexation.
4. Crystal Chemistry: Nature of Solids; Bonding Forces; Covalent and Ionic Radii; Solid Solutions; Trace Elements in Minerals; Phase Diagrams; Geothermometry; Reaction Kinetics; Diffusion; Surface Reactions; Diagenesis.
5. Isotopes in Geology: Nuclides and nuclear numbers; Radioactivity; Radioactive clocks; Dating of rocks and minerals; Stable isotope geochemistry
6. Topics in Geochemistry: Applications of geochemistry to the study of igneous, metamorphic and sedimentary environments.

The Exceptional Contributor: “The Class Was Better Because You Were Here.

As part of the learning process all students are expected to participate actively in class. Here are some guidelines to keep in mind when in class:

- You provide clear, concise, and correct explanations that help others gain a better understanding of concepts.
- You make outstanding, original, and informative comments.
- You make highly attentive and constructive comments on other people's statements.
- You ask questions that are penetrating or help clarify.
- You raise your hand strategically (understanding that there are other students in class).
- You actively encourage others to express their ideas.
- You display body language that communicates interest in what others are saying.
- You arrive to class on time and are not absent without reason.

University Policies:

Statement on Academic Offences: "Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

<http://www.uwo.ca/univsec/handbook/appeals/scholoff.pdf>"

"The written assignment may be subject to submission for textual similarity review to the commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (<http://www.turnitin.com>)."

Student's responsibilities in the event of a medical issue:

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Academic Counseling Unit at the Faculty of Science as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained. For further information please see: <http://www.uwo.ca/univsec/handbook/appeals/medical.pdf>

A student requiring academic accommodation due to illness, should use the Student Medical Certificate when visiting an off-campus medical facility or request a Records Release Form for visits to Student Health Services. The form can be found at:

https://studentservices.uwo.ca/secure/medical_document.pdf

Accessibility Statement

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x.82147 for any specific question regarding an accommodation.

Topics in "Elements"
see ejournals on the library website

2013

- Garnet: Common Mineral, Uncommonly Useful
- Nitrogen and Its (Biogeocosmo) Chemical Cycling
- Continental Crust at Mantle Depths
- The Mineral-Water Interface
- Serpentinites
- One Hundred Years of Geochronology

2012

- Urban Geochemistry
- Rare Earth Elements
- Granitic Pegmatites
- Fukushima Daiichi
- Minerals, Microbes, and Remediation
- Impact!

2011

- Mine Wastes
- Tourmaline
- When the Continental Crust Melts
- Global Water Sustainability
- Iron in Earth Surface Systems
- Cosmochemistry

2010

- Sustainable Soil Remediation
- Thermodynamics of Earth Systems
- Atmospheric Particles
- Fluids in Metamorphism
- Sulfur
- Mineral Evolution

2009

- Metal Stable Isotopes: Signals in the Environment
- Gold
- Mineral Magnetism: From Microbes to Meteorites
- Gems
- Bentonites – Versatile Clays

- Scientific Exploration of the Moon

2008

- Nanogeoscience
- Carbon Dioxide Sequestration
- Platinum-Group Elements
- Deep Earth and Mineral Physics
- Phosphates and Global Sustainability
- Supervolcanoes

2007

- Zircon: Tiny but Timely
- Energy: A Geoscience Perspective
- Frontiers in Textural and Microgeochemical Analysis
- The Critical Zone
- Medical Mineralogy and Geochemistry

2006

- User Research Facilities in the Earth Sciences
- Arsenic
- Water on Mars
- Early Earth
- Glasses and Melts: Linking Geochemistry and Materials Science
- The Nuclear Fuel Cycle Environmental Aspects

2005

- Fluids in Planetary Systems
- Diamonds
- Genesis: Rocks, Minerals, and the Geochemical Origin of Life
- Toxic Metals in the Environment: The Role of Surfaces
- Large Igneous Provinces: Origin and Environmental Consequences