College of Science **Department of Earth Science**

Course Code: ERSC 4031 Course Title: Geochemistry

General Information

Number of Credits: 3
Instructional Format: KeyNote Presentations; Text, Data, PDF, and GPS files on Moodle
Contact Hours/Week: 6 (officially, but generally several hours more)
Prerequisite: Chemistry Introduction & Lab, Introduction to Geology ERSC 2101
Co-requisite:
Assessment: mid term and final exams, lab reports, trip and field report
Grading (A–F, Pass/Fail): A-F
Textbook: a) Rollinson, Early Earth Systems,
b) Rollinson, Using Geochemical Data
References (optional): Internet

1. Course Description

- History of (Geo-)Chemistry
- Sampling & Analysis
- Atoms, Elements, Minerals
- Isotopes
- Origin & Distribution
- Diversification
- Exploration
- Aquatic Chemistry
- Environments Overview
- Biogeochemistry
- Environmental Geochemistry
- Thermodynamics (Intro, included in several of the other chapters)

2. Course Objectives

Make the students aware of chemical processes governing geology (also influencing biology) and leading to the ongoing differentiation (not only in magmatic systems) of materials; learn how to geochemically analyse geological materials (minerals) with field and laboratory techniques.

3. Learning Outcomes *[Use Bloom's taxonomy]*

*[Specific descriptions of **realistic, achievable, observable and measurable acquisition** of knowledge and development of skills (abilities/competencies) and attitudes (values/disposition) expected of students on successful completion of a given course. These statements are student-centred and should not exceed 6. Each outcome can be related to the specific programme outcomes as provided in the programme outcome matrix].*

Maybe, somebody with more time at hand can do this matrix-related stuff for me, I would be most obliged. I try to teach on a realistic basis that, hopefully, comes up with some achievable goals for the students.

(a) ***Knowledge and Understanding*** *ability to recall and explain important information and concepts in the course* = yes, that sounds good

(b) ***Skills (Thinking)*** *This refers to application/analysis/synthesis/evaluation/practical use of the knowledge gained in the course* = sounds also good; however, I have a larger emphasis on critical thinking and application of the knowledge about one process and applying it to another unknown process to evaluate it; learning by heart is not my aim. Another important skill is practical work applied to raw materials (minerals/rocks) and the related identification of materials and associated processes.

(c) ***Attitudes*** (optional) *This refers to type of attitude a student will have acquired from the course, such as team work, critical thinking, ethics issues, etc*. = this doesn't sound good, because the attitudes change from student to student and there are good and bad attitudes which, in many cases, don't change during one semester (also extremely difficult to change if the willingness doesn't exist). My assessment for the points above follows below - I am trying to change these attitudes, at least in a handful of students:

Reading without being asked:	???
Team Work:	poor; only advanced while getting exam papers copied and distributed
Critical Thinking:	very poor (at least for many)
Ethics:	what is that?

4. Assessment

Midterm	25%
Final	40%
Lab Attendance & Reports	30%
Field Attendance & Report	5%

Assessment Criteria

Learning outcome:	**Assessment criteria** *[For each learning outcome state the level of understanding a student needs to demonstrate to be able to achieve a specified grade.)]*				
	A	**B**	**C**	**D**	**F**
By the end of the course, students will be able to*:* These criteria comments as warranted in this table are superfluous and have no meaning at all for REAL TEACHING, because it is simply impossible to cater (alone!) for the needs of 50-65 students in labs (where you normally have more access to them than in the lecture)	The student has a reasonable idea about what was taught (see topics) and he/she may even be able to apply some of the concepts to unknown processes I will be very happy to have achieved this	these comments/assessments of the grades fall between A and F			The student has no idea about what was taught and he/she will not be able to apply any of the concepts to other processes I will be very unhappy about this

5. Course Structure

The course is designed to be delivered in one semester of 15 weeks with 6 contact hours per week (2 lectures and 2x2=4 labs) plus 1 full day on a weekend (Thursday) for the field trip. The course weight is 3 credit hours.

6. Topics

[A breakdown of the syllabus into major components listed logically and by weekly coverage if need be. This should be detailed enough to enable another instructor to teach the course at the same level.]

Comment: *Another instructor will most likely not follow the same path, because he/she will have a different background!*

Unit	Topics	Sections	Lectures/Weeks
1	Introduction	History of Chemistry/Geochemistry, Context between Geochemistry, Geology, and Life	1
2	Sampling	Sampling Techniques	1/2
3	Geochemical Analysis	Analytical Techniques, Data Treatment	1/2
4	Atoms, Elements, Minerals	Make-up of Atoms, Elements, Minerals, Bonding	1
5	Isotopes	Stable Isotopes, Radioactive Isotopes, Decay, Fractionation Processes, Geochemical Use of Various Isotopes, Age Dzating	2
6	Origin	Big Bang, Cosmological and Stellar Nucleosynthesis, Building Blocks of Universe, "Geochemical' Conditions on other Planets of our Solar System	2
7	Diversification of Geological Components	Differentiation and Diversification of Earth Systems (Melts, Rocks, Waters, Gases), Chemical Weathering, Biochemical Influences	3
8	Exploration	Terminology, Strategies, Geochemical Mapping	1
9	Aquatic Geochemistry	Water: Major Components, Physicochemical Behaviour, Classification Schemes; Input/Output Processes, Important Facts about Eh and pH of Waters	1
10	Environmental Geochemistry	Interdependency of Element Cycles, Examples of Cycles (Water, Oxygen, Carbon, Nitrogen, Phosphorous, Nutrients) and their Impact, when Disturbed	2
11	Biogeochemistry	Mineral Evolution, Biomineralisation and Biomobilisation	1

7. Lab/tutorial content

Week	Content
2	Lab & Field Safety
3	Using Senses to Distinguish/Identify Elements (Metals, Gangue Materials) and Valencies of Metals
4-5	Valencies and Redox Reactions
6	Experimental Element Determination: Luminescence, Fluorescence, Phosphorescence, Thermoluminescence
7-8	Analytical Element Determination: Flame Colours, Borate Glass Bead

9-12	Analytical Element Determination: X-ray fluorescence, Sample Analysis from Field Trip; Data Treatment: Normalisation (Enrichment/Depletion), Discrimination
13-14	Geochemical Map and Resource Evaluation for Exploration
Field Trip (Weekend)	Visit of Various Outcrops of Pillow Basalt, Hydrothermally Leached Basalt, Basalt with Sulfide Impregnations, and Chemically Destroyed Basalt (Gossan) from Localities in Close Proximity to Each Other Sampling of the Different Rock/Chemical Precipitates for Geochemical Analysis (see labs above)