COURSE CONTENT

Date	:	Mar 22, 2016
Academic Year	:	2016/2017
Study Year (if applicable)	:	3 and 4
Course Code & Title	:	ES3003 Introduction to Geochemistry
Academic Unit	:	4 AUs
Pre-requisite	:	ES1003 E2S2 Solid Earth
Co-requisite	:	N.A.
Mutually exclusive with	:	N.A.
Course Description	:	

This course is designed to introduce students the principles of chemistry related to geology and their applications to understand processes taking place on and within the Earth. By the end of the course, students should become familiar with the basic geochemical tools, and be able to use these tools to solve, in a quantitative manner, some geological and environmental problems, for example, measuring geological time, unravelling the continental and oceanic evolutions, and understanding the current climate change.

ES3003 Introduction to Geochemistry
[Lectures: 39 hours; Tutorials: 13 hours; Pre-requisites: ES1003; Academic Unit: 4.0]

Learning Objective
The aim is to provide the students with a powerful toolbox and the related skills, more than a static bank of knowledge. They will become familiar with the principles of geochemistry, including analytical chemistry, governing equations and typical applications in the Earth Systems Sciences (oceans, solid earth, atmosphere, biosphere). They will learn to organize and present geochemical data, including writing a report on a problem of their choice. With this set of tools and knowledge, the students will have the mind skills and technical know-hows to answer a range of practical problems, including some that may not have been addressed in the class.

Content
We will investigate large scale processes occurring in the geosphere, hydrosphere, biosphere, atmosphere and anthroposphere using major and trace element geochemistry and stable isotopes. We will discuss processes such as element and isotope fractionation, element transport and mixing as well as radiogenic isotopes and their application for geochronological purposes. Hands-on data collection and analysis will be core to the students learning experience and will be done during tutorials and assignments.

Week	Course Outline (Lecture)	Tutorial
1	The properties of elements	States of matter, geochemical classifications
2	Mass conservation and elemental fractionation	Elemental fractionation
3	Fractionation of stable isotopes	Major stable isotopic systems
4	Geochronology and radiogenic tracers	Principles of rock dating
5	Element transport	Diffusion, advection
6	Geochemical systems	Geochemical cycles
7	The chemistry of natural waters	Precipitation, weathering and erosion
8	Biogeochemistry	The chemistry of life and biominerals
9	Environments	Ancient climates
10	Mineral reactions	Diagenesis, metamorphism
11	The solid Earth	Magmatism
12	The Earth in the Solar System	Examples of rock dating
13	Modern geochemistry: The food industry, forensic sciences	Applying geochemical principles to society

Learning Outcome

(1) Knowledge on the principles and tools of geochemistry
(2) Intellectual flexibility and critical thinking: Identifying the most useful geochemical tool for a given problem
(3) Formulating questions about the dynamics within Earth System Sciences
(4) Research: hands-on acquisition, analysis and interpretation of geochemical data
(5) Problem solving: application of governing equations to investigate main geochemical processes
(6) Interdisciplinary: applications of geochemical principles to a wide variety of problems (atmosphere, hydrosphere, biosphere, solid earth, anthroposphere)

Student Assessment

Students will be assessed by:

- Weekly assignments (30%)
- Midterm presentation (30%)
- Group project report (40%)

Students will be assessed based on exercises of data acquisition and analysis conducted during tutorials. They will also have a semester-long group project for which they will have to prepare a midterm oral presentation to share their findings with their fellow students and an end-term report.

Resources/Textbooks/References

Geochemistry: An Introduction – F. Albarede, Cambridge University Press, 2nd edition (ISBN-13: 978-0521706933)