Universitat Autònoma de Barcelona

2021/2022

Basic Geochemistry

Code: 102490
ECTS Credits: 6

Degree	Type	Year	Semester
2502444 Chemistry	FB	1	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Juan Francisco Piniella Febrer
Didac Navarro Ciurana
Ignacio Ramón Mata Martínez
Joan Poch Serra
Isaac Corral Calleja

Prerequisites

There are no prerequisites. Having taken a course on Earth Sciences and Environment in high-school can help to follow the course but it's not a prerequisite.

Objectives and Contextualisation

Contextualitzation

The course constitutes a basic training that develops a cross-cutting vision on Geology taking special emphasis on the aspects with more concomitances with Chemistry. Geochemistry, Crystallography and isotopic dating methods are particularlyrelevant in this context.

Formative objectives

1) To know the main branches of Geology and its various objectives.

2) To know the structure and composition of the Earth and its timeframe.

3) To recognize the main geological materials (minerals and rocks) and to know the concept of crystallinity and the tools that allow its study.

4) To apply the basic principles of thermodynamics to the study of mineral balances.

5) To know the composition of the main fluids of the Earth and their interaction with the rocks.

6) To know the principles of isotopic geochemistry and its main applications.

7) To relate the various natural resources with the corresponding artificial reagents and industrial materials.

8) To know the main geochemical problems of global scope.

Competences

- Learn autonomously.
- Manage the organisation and planning of tasks.
- Manage, analyse and synthesise information.
- Reason in a critical manner
- Recognise and analyse chemical problems and propose suitable answers or studies to resolve them.
- Show sensitivity for environmental issues.

Learning Outcomes

1. Learn autonomously.
2. Manage the organisation and planning of tasks.
3. Manage, analyse and synthesise information.
4. Reason in a critical manner
5. Relate and apply concepts of geology and chemistry to analyse aspects of the Earth and its environmental problems.
6. Show sensitivity for environmental issues.

Content

0.- INTRODUCTION

Geology, what is this?

Organization of Geology in subdisciplines and affinities with other sciences.

1.- EARTH STRUCTURE AND GLOBAL TECTONIC. SPACE AND TEMPORARY SCALES.

External fluid layers.

The internal structure.

Origin of chemical elements from the Earth and the Cosmos.

Primary and secondary geochemical differentiation

Geochemical classification of the elements

Plate tectonics

Timescales

2.- EARTH CHEMICAL: NATURE OF THE SOLID STATE, MINERALS AND ROCKS

Solid state and crystallinity

Point and spatial symmetry

Properties used for mineral identification

Chemical and structural classification of minerals

Rock classification criteria

3.- STABILITY OF MINERALS: PHASES AND MINERAL EQUILIBRIA.

Thermodynamic basics

Polymorphism and solid solutions

Phase diagrams: construction, reading and applications

Phase balances in the lithosphere (metamorphic equilibria)

Phase balances in the lithosphere (igneous equilibria)

4.- EARTH FLUIDS : MAGMAS, GASES, WATERS, HYDROCARBURS.

Magmas, environments of formation and magmatic differentiation.

Gases, formation and evolution of the atmosphere.

Waters, hydrological and geochemical cycle.

Hydrocarbons, training and evolution.

5.- WATER-ROCK INTERACTION: LOW TEMPERATURE GEOCHEMICAL PROCESSES

Chemical and biochemical meteorization.

Alteration reactions and fluid analysis.

Foundation and diagenesis

Others (ion exchange, dolomitization, laterization and autogenic biomineralization).

6.- ISOTOPIC GEOCHEMISTRY PRINCIPLES AND APPLICATIONS.

Stable isotopes: isotopic fractionation.

Stable isotopes: applications.

Radiogenic isotopes: radioactive processes.

Radiogenic isotopes: radiometric dating, applications.

7.- THE EARTH AS A SOURCE OF MATERIALS AND CHEMICAL PRODUCTS

Industrial rocks

Acid production (H_2SO_4, HNO_3, HCl and H_3PO_4).

Gas production (NH_3, Cl_2, H_2).

Production and uses of phosphates.

8.-GLOBAL GEOCHEMICAL PROBLEMS.

Air pollution (O_3, CO_2, smog).

Eutrophication and sewage treatment.

Contamination of soils and water.

Urban waste treatment.

Treatment of radioactive waste.

Methodology

Theoretical classes

The student acquires the knowledge of the subject by attending the theoretical classes that occasionally complement each other with simple questions and exercises that are presented with the corresponding explanations. This is the aim of active student participation so that the flux of interaction if not unidirectional.

Tutorials

The process of learning and acquiring competencies will be supervised by the teacher through individual and/or group tutoring. Formally a date is assigned for the tutoring but the teacher of the subject will be available to the students to arrange appointments to solve the doubts and follow the evolution of the aforementioned process of learning and competence acquisition.

Sessions of problems

Interspersed with the theoretical classes there are a set of supervised sessions that aim at facing problems related to each of the topics that make up the theoretical classes. Problem sessions combine mathematical skill with critical reasoning.

Practical sessions

These are 3 practical sessions of 2 hours, these are interspersed with the theoretical and problem sessions, they are intended to make the student connect the explanations with the actual geological subdisciplines. Basically these deal with materials at 3 levels: ordering the crystalline matter (notions of point symmetry), mineral recognition and rock recognition. This working approach aims at promoting active learning and developing critical reasoning and analytical and synthesis capacity.

Reading and studying the fundamentals

Notes corresponding to all program topics are available on the Virtual Campus, along with all the presentations that the teachers use in the theory sessions can also be downloaded through the Virtual Campus. The student should spend more of his autonomous working time reading this available materials, along with their notes.

Preparing and solving autonoumously problems

The issues raised in the problem sessions are available on the Virtual Campus prior to inperson activities. It is intended that the student attend the sessions having prepared the issues in order to make the most of the attendance at the problems sessions. In addition, it is intended that the student take some time to conveniently write down the resolution of the problems to promote order and for the teachers could occasionally ask for them to collect evidence for an individual assessment of students.

Autonomous assimilation of acquired learning into practices

It is intended that the student spend time autonomously consolidating the learning achieved with the practices to stimulate the order and also because the teachers could occasionally ask for them to collect evidence for an individual assessment of students.

Search for information

Student-made material and material available through the Virtual Campus can be supplemented through information from alternatives sources: libraries and the Internet for instance. Preparing problems may also require the search for information.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theoretical sessions	36	1.44	3, 4
Type: Supervised			
Practical sessions	6	0.24	2, 3, 4
Sessions of problems	10	0.4	2, 3, 4
Tutoring	1	0.04	2, 3, 4
Type: Autonomous			
Autonomous assimilation of the acquired knowledge in the practices	9	0.36	1, 2, 3, 6, 4
Preparation and resolution of problems autonomously	15	0.6	1, 2, 3, 6, 4
Reading and study of the theory	55	2.2	1, 3, 4
Search for information	6.5	0.26	1, 3, 6, 4

Assessment

The evaluation of the subject will be based on the continuous evaluation of the process of acquisition of knowledge and competences and it will consist of:

- Tests for monitoring the teaching contents through the Virtual Campus (2 will be made coinciding with the dates of completion of the two partial exams)

- A first 3-hour partial exam that includes the evaluation of:

- The theory content of the first part of the subject (definable depending on progress in the programmatic exhibition, usually includes the first three topics)

- The contents of the problem sessions of the first part of the subject.

- The contents of the practical sessions that have been held (depending on the scheduled dates this will correspond to the first sessions or sessions 1 and 2).

- A second 3-hour partial exam that includes the evaluation of:

- The theory content of the second part of the subject (definable depending on progress in the programmatic exhibition, usually includes the last five topics)

- The contents of the problem sessions of the second part of the subject.

- The contents of the practical sessions that have been held (depending on the scheduled dates this will correspond to the third session alone or sessions 2 and 3).

- A final (second-chance) exam (optional for those who have passed the partials) to pass (or improve the mark) that will be made up of two different exams corresponding to the two partials, so that students can take only one or both.

Access to the final exams will only be granted to those students who had previously developed evaluation activities during the course that account for 2/3 of the final grade.

In addition, evidence of the activity in the classroom of the students will be collected through which a mark will be produced, this mark can be used to modify slightly for cases of marks that are on a certain threshold (fail/pass, pass/good or goog/excellent (or outstanding).

Attendance and, above all, active class participation, will also be valued as additional merits.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
1st parcial exam (theory + practice 1)	34	2	0.08	1, 2, 3, 6, 4
1st partial exam (problems)	11	1	0.04	2, 3, 4, 5
2on parcial exam (problems)	11	1	0.04	2, 3, 4, 5
2on partial exam (theory + practice 2 i 3)	34	2	0.08	1, 2, 3, 6, 4
Final exam (2on chance 1st partial exam)	45	1.5	0.06	1, 2, 3, 6, 4
Final exam (2on chance 2nd partial exam)	45	1.5	0.06	1, 2, 3, 6, 4
Virtual tests	10	2.5	0.1	1, 2, 3, 6, 4

Bibliography

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C-J. Allègre and G. Michard. Introduction to Geochemistry, D. Reidel Publishing Company, Dordrecht-Holland, 1974. 142pp.

A. Bauer and B. D. Velde, Geochemistry at the Earth's Surface, 2014, Berlin, Springer

W. H. Schlesinger and E. Bernhardt, Biogeochemistry : an analysis of global change, 2013, San Diego, Academic Press

P. Vidal. Géochimie. Dunod, Paris, France, 1998. 190pp.

J. V. Walther. Essentials of Geochemistry, Jones and Bartlett Publishers, Sudbury, Massachusetts, USA, 2005. 704pp.

Presentacions molt didàctiques sobre diversos temes de Geologia: http://www.ig.uit.no/webgeology/

Material didàctic sobre grups de simetria puntual:
http://www.uab.cat/web/la-divulgacio/grups-puntuals-de-simetria-1345664584325.html

Software

No specific software is required. Mastering basic spreadsheet software (Excel or Origin) to treat and plot data would be useful.