Universitat Autònoma de Barcelona

2023/2024

Geochemistry

Code: 101035
ECTS Credits: 7

Degree	Type	Year	Semester
2500254 Geology	OB	3	1

Contact

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Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject. Please note that this information is provisional until 30 November 2023.

Teachers

Gumersinda Galan Garcia

Prerequisites

It is advised to have passed Fundamentals of Geology, Chemistry of the Earth, both subjects of the 1st year, and Mineralogy of the 2nd year.

Objectives and Contextualisation

Geochemistry is a compulsory subject of Geology that provides chemical tools to approach different types of geological processes in order to discuss them using physic-chemical fundamentals. The syllabus is thought to enlarge the items included in the subject Chemistry of the Earth (1st year). In addition, Geochemistry gives a complementary point of view to understand other subjects of the Geology Degree, such as Earth Planet, Fundamentals of Geology, Mineralogy, Sedimentology, of 1st and 2n year, and is clue to get further insight into other subjects: Igneous Petrology, Metamorphic Petrology, Sedimentary Petrology, Ore Deposits, Environmental Geochemisty, Edaphology, Present Geologycal Environments, Geology record of the Global Change and Geology risks of chemical type, which are all of them subjects of 3rd and 4th year.

The general aims of Geochemistry are: (I) to introduce the distribution of chemical elements in the Earth planet as part of the Solar System, and in more detailed scale in rocks, minerals, fluids and the Earth atmosphere; (2) to explain the causes of the chemical compositions of all these Earth materials, taken into account chemical reactions involved in the internal and external geological processes; and (3), to estimate the age of Earth materials using different geochronometers.

Detailed aims to achieve from lectures are:

- To be aware of the importance of geochemical methods to solve geological questions.

- To relate the abundance of chemical elements to their nuclear stability and nuclear reactions to form them.

- To apply the decay of radioactive isotopes to date geological processes; establishing the limitations of these methods.

- To reason the behaviour of chemical elements in natural systems (minerals, magmas, fluids and vapour) based on chemical fundamentals.

- To relate the chemical composition of the Earth and the Solar system to the geochemical differentiation processes that took place during their formation.

-To assessthe chemical compositions of igneous, sedimentary and metamorphic rocks based on geochemical differentiation.

- To relate the mineral stability in aqueous systems to the chemical composition of natural water.

- To assess the difference between ideal and non-ideal solutions.

- To get skills in applying fundamentals of thermodynamic laws to solve questions of chemical equilibrium relevant to geology: case study (oxidation-reduction reactions in weathering processes).

- To reason the behaviour of stable isotopes in geological processes.

Detailed aims to achieve from practices are:

- To get skills in using analytical parameters common in Geochemistry.

- To assess geochemical data statistically.

- To relate mineral compositions to whole-rock compositions.

-To get skills in using different sampling methods for rocks and natural water, and in sample preparation previous to the analysis.

- To get insight into some of the most common physical analytical methods for rocks and minerals.

- To estimate and discuss geochronological ages of rocks and minerals

- To get skills in using the adequate software to deal with the presentation of geochemical data in different types of diagrams.

- To solve questions of mineral stability and oxidation-reduction reactions in the environment.

Competences

- Display knowledge of the applications and limitations of geophysical methods for learning about the Earth.
- Learn and apply the knowledge acquired, and use it to solve problems.
- Process, interpret and present laboratory data using qualitative and quantitative techniques, and suitable computer programmes.
- Show an interest in quality and incorporate it into practice.

- Suitably transmit information, verbally, graphically and in writing, using modern information and communication technologies.
- Synthesise and analyse information critically.
- Use chemistry concepts when solving problems in geology.
- Work independently.

Learning Outcomes

1. Define geochemical concepts applied to the study of geology, and know their limitations.
2. Depict geochemical and geophysical data graphically: phase diagrams, compositional diagrams and methods of geophysical representation.
3. Learn and apply the knowledge acquired, and use it to solve problems.
4. Show an interest in quality and incorporate it into practice.
5. Suitably transmit information, verbally, graphically and in writing, using modern information and communication technologies.
6. Synthesise and analyse information critically.
7. Use advanced notions in chemistry to understand and solve geological problems .
8. Work independently.

Content

Lectures

Chapter 1. Historic development and aims of Geochemistry.

Chapter 2. The abundance of chemical elements: nucleosynthesis.

Chapter 3. Geochemical behaviour of elements in minerals, rocks and Earth fluids.

Chapter 4. isotopic geochronometers.

Chapter 5. Compositions and geochemical differentiation in the Solar System, Earth System, in Igneous, sedimentary and metamorphic rocks and in the hydrosphere.

Chapter 6. Chemical reactions and mineral stability in aqueous systems.

Chapter 7. Elementary thermodynamics for geological systems.

Chapter 8. Oxidation-reduction reactions in nature.

Chapter 9. Isotope fractionation

Laboratory practices and seminars.

1. Seminar: the meaning of chemical analysis.

2. Seminar: formation of chemical elements and stellar evolution (Suplementary to chaper 2).

3. Practice: statistic assessment of geochemical data and geochemical estimates.

4. Seminar: sampling methods and preparation of solid samples and water for analysis.

5. Seminar: theoretical fundamentals of the most common physical analytical methods in geology.

6- Practice: estimates and evaluation of geochronological ages of minerals and rocks (supplement to chapter 4).

7. Practice: fundamentals of geochemical diagrams (supplement to chapter 5).

8- Practice: exercices of mineral stability in aqueous systems (supplement to chapter 6).

9- Practice:case studies of oxidation-reduction geological processes (supplement to chapter 8).

Methodology

To achieve competences in geochemistry, the student must attend lectures, seminars and practicals and to complete data doing tasks and using the recommended references. Exercices will be solved either in class or as home work. Later, they will be supervised by the teacher during the practicals or during the tutorials. Also, some issues from the different chapters must be further developed by the students, either working on his/her own or in groups, and presented during the tutorials, where they will be discussed along with other possible questions on any theoretical or practical issues.

Complementary graphics will be used during the lectures, seminars and practicals and provided to the students via Virtual Campus. Other related documents will be also available this way. Part of the practicals will be done in the computing classrooms, if they are available.

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			
Lectures	32	1.28	6, 1, 4, 7
Seminars and practical works	27	1.08	6, 3, 1, 4, 2, 5, 7
Type: Supervised			
Personal tutorials to clarify topics	14	0.56	3, 1, 7
Type: Autonomous			
To do tasks, to solve exercises and to prepare oral presentations (evidence)	45	1.8	6, 3, 1, 4, 2, 5, 8, 7
To study the subject	45	1.8	6, 3, 1, 4, 5, 8, 7

Assessment

The following items will be considered for evaluating the student on the competences of this subject:

1.Skipping practices more than 25%, without a reason, will be punished with 5% discount on the final qualification.

2. Delivering tasks, doing one oral presentation and the regular work on practices, collaborating in solving exercises (evidence) will account for 20% of the global qualification (distributed into 15% for the tasks on lectures and oral presentations and 5% for the practicals)

3. Passing either two partial exams on both lecture chapters and practicess (or a sole first global exam) and/or a second-chance final exam of the whole subject will count 80%, distributed into 50% for the exam on lectures and 30% for the exam on practicals. For passing each partial exam (or global exam) a minimum of 4 points is required between the lecture part and the practices. However, qualifications on the lecture part and on the practices will not compensate each other if the former is <2 of a total 5 and the latter is <1 of a total 3. Students getting <3 points of total 8 in one or both partial exams, (or in the first global exam) must take the second-chance global exam which has the same rules as the partial or global exams. To take this second-chance exam, it is required that the student has previously taken the two partial exams or the global exam.

To be successful, the student must get a minimum of 5 points considering items from 1 to 3. Items 1 and 2 will not have a second-chance opportunity. The exam qualification will be the average qualification of the two partial exams, the qualificaton off the irst global exam, or of the second-chance global exam.

Students who pass the two partial exams, or the first global exam, but want to improve their qualification can also take the second-chance exam.

The date of the first global exam will be that of the 2n oarcial exam, if the student chooses continuous evaluation. The date of the second-chance exam will be the same form everybody.

If the continuous assessing of a student is>35%, the student cannot apply for the "Not have beentaken" qualification

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Delivering tasks, doing oral presentations, regular work and collaboration in solving practical exercises (evidence)	20% of the global qualification	5	0.2	6, 3, 1, 4, 2, 5, 8, 7
To control the attendance to practicals (75% minimum)	- 5% of the global qualification if the attendance is less than 25%	0	0	4
Two partial exams on lectures, or a sole global exam) and/or one second-chance exam (see rules)	47,5%	4	0.16	6, 1, 4, 8
Two partial exams on seminars and practical works (or one sole global exam) and/or one second-chance exam (see rules)	32,5%	3	0.12	6, 3, 1, 4, 2, 5, 8, 7

Bibliography

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FAURE G. (1998).- Principles and Applications of Geochemistry. Prentice Hall.

FAURE G. (1977, 1986).- Principles of Isotope Geology. John Wiley & Sons.

GILL R. (1989).- Chemical fundamentals of Geology. Unwin Hyman.

GILL R. et al. (2016).- Modern analytical geochemistry. An introduction to quantitative chemical analysis techniques for Earth, Environmental and Materils Sciences Longman. Routladge.

KRAUSKOPF K.B. , BIRD D.K. (1995). Introduction to Geochemistry. (3ª eidición). McGraw-Hill.

McSWEEN H.Y, RICHARDSON S. M., UHLE M. E. (2003). Geochemistry. Pathways and Processes. Columbia University Press.

MISRA, K.C. Introduction to Geochemistry Principles and Applications. Wiley-Blackwell

ROLLINSON H. PEASE, V.(2021).- Using geochemical data to understand geological processes. Cambridge University Press.

WALTER J.V. (2005). Essentials of Geochemistry. Jones and Bartlett Publishers.

Software

EXCEL spreadsheets and software for triangular diagrams (eg. TriPlot) will be used.