Environmental Geochemistry

Code: 101068
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500254 Geology	OT	3
2500254 Geology	OT	4

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

Students are advised to have acquired the basic skills of the subject of Geochemistry.

Objectives and Contextualisation

Objectives:

- To understand the main physico-chemical processes that regulate the distribution and mobility of pollutants.

- To provide tools for identifying and interpreting environmental problems.

- To learn about remediation strategies for environmental problems.

- Develop and evaluate possible solutions for environmental problems in which geochemistry is involved.

- To learn about possible job opportunities related to environmental geochemistry.

Competences

Geology

- Display knowledge of the applications and limitations of geophysical methods for learning about the Earth.
- Display understanding of the size of the space and time dimensions of Earth processes, on different scales.
- Evaluate moral and ethical problems in research and acknowledge the need to follow professional codes of conduct.
- Identify and tackle environmental problems, plan land-use and know the principles of prevention and mitigation of geological risks.

- Process, interpret and present field data using qualitative and quantitative techniques, and suitable computer programmes.
- Process, interpret and present laboratory data using qualitative and quantitative techniques, and suitable computer programmes.

Learning Outcomes

1. Apply Geochemistry concepts to solve problems of land and water pollution.
2. Assess changes to geological environments and their level of degradation resulting from direct anthropogenic action or climate change.
3. Describe, analyse, evaluate, plan and manage the physical environment and the geological heritage.
4. Evaluate and process laboratory data corresponding to environmental issues.
5. Identify and process the value and the sources of field data with environmental implications.
6. Interpret relief dynamics on different time-space scales in terms of risk and land-use planning.
7. Plan the successive exploration stages for each type of project and the development stages from the perspective of sustainability, to avoid irreparable losses of resources and/or geological heritage.
8. Synthesise and select field data and process it qualitatively and quantitatively using different computer programmes.
9. Undertake professional activity in the field of environmental geology, complying with moral and ethical principles.
10. Use low-temperature geochemistry to identify environmental problems.

Content

Theory:

1. Mineralogy and geochemistry of pollutants: Classes and characteristics of pollutants. Organic pollutants. Inorganic pollutants. Mobility and disposition of pollutants in the exogenous cycle.

2. Atmospheric pollution: Composition and structure of the atmosphere. Energy transfer in the atmosphere. Selective absorbing gases and greenhouse effect. Chemical and photochemical reactions in the atmosphere. Urban atmosphere. Atmospheric particles.

3. Soil contamination: Physic-chemical properties of soils. Origin of soil contamination. Factors influencing soil contamination. Different examples of soil contamination. Remediation techniques for contaminated soils.

4. Water pollution: Basic concepts of hydrochemistry. Water quality. Water uses and management. Surface and groundwater water pollution. Prevention, measurement, control and remediation of polluted water.

5. Isotopy of pollutants. Basic concepts. Radioactive isotopes. Stable isotopes. Environmental isotopes and their applications in contamination studies. Examples.

6. Sampling techniques in environmental geochemistry. Applications in atmosphere, soil and water. Sampling strategies.

Exercises and project-based practice

Geochemical problems on atmospheric, soil and water contamination cases.

Project-based practice.

The aim of the project is to encourage participatory teaching, promoting the scientific method and critical thinking. During the development of the project-based practicals, a real study will be carried out in an environment contaminated by compounds dissolved in water. In this environment there are two entities that can cause pollution. The students, in groups, will have to determine who is causing the contamination by working with geochemical data. The following aspects will be worked on during the project.

1. Hydrogeological and geological contextualisation of the case study.

2. Sampling decision making.

3.Treatment and interpretation of hydrochemical data I: ionic balance, analytical quality, classification of water in Piper diagram with the use of Excel software.

4. Hydrochemical modelling I: speciation using Phreeqc software.

5. Hydrochemical modelling II: saturation index using Phreeqc software.

6. Treatment and interpretation of isotopic data I: calculation of the local meteoric line and evaporation line.

7. Treatment and interpretation of isotopic data II: calculation of mixing lines and quantification of contamination.

8. Joint discussion of all data and processing of the project.

Seminar (dedicated to the following or related items):

The work of the geologist in environmental geochemistry. Case studies.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Master classes	26	1.04	1, 2, 3, 6, 9, 10
Practices / Problems / Exercises	15	0.6	5, 6, 7, 8, 10
Seminars	10	0.4	1, 2, 9
Type: Autonomous			
Study of topics and carrying out exercises using specific programs and the recommended bibliography.	81	3.24	1, 3, 6, 7, 8, 9, 10

Master lessons

By attending master lessons, students acquire the scientific knowledge of the subject, which they must complete with the study of the topics explained.

Exercises and practical work

In the exercises, environmental geochemistry problems focused on pollutants will be presented. In the practical work, real cases will be analysed in which students will have to evaluate and respond to environmental problems. Real cases will be analysed.

Seminars

These are sessions in which the theoretical and practical aspects taught in the master lessons are reinforced, allowing students to work on theoretical aspects by applying them to concrete cases.

Note: 15 minutes of a class will be reserved, within the timetable established by the centre/degree, for students to fill in the evaluation surveys of the teaching staff and the evaluation of the subject/module.

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.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Delivery of a paper on an assigned topic.	15	4	0.16	2, 4, 6, 7
Partial theoretical and practical exams and final exam	70	8	0.32	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Practices / Problems / Exercises to be delivered	15	6	0.24	5, 7, 8, 10

In this subject the theoretical and practical skills and competences will be assessed by means of CONTINUOUS ASSESSMENT (CA) following the following guidelines:

EXAMS: The partial exams with a grade lower than 3 will have to be recovered in the final exam.

GROUP WORK:

Theoretical-practical exams and final recovery exams: 70% of the mark: 2 partial theoretical-practical exams (35% each).

A minimum mark of 3 must be obtained in each partial exam in order to obtain an AC mark.

PROBLEMS AND PRACTICAL GROUP WORK:

Problems/exercises will be required to be handed in: up to 5% of the grade.

Group work will be required to be handed in: 25% of the grade. The work will be delivered in electronic format. The work will have to respect the rules (script, format) specified by the teachers, especially the rules of proper accreditation of all the material used. In case of failure to clarify the origin of all the material used, the work will automatically receive a grade of 0 points.

CONTINUOUS ASSESSMENT SCORE

The final CA grade will be calculated as follows:

Grade of the 1st partial x 0.35 + Grade of the 2nd partial x 0.35 + Grade of the work x 0.25 + Grade of the problems/exercises x 0.05.

The AC grade will only be calculated if in both midterms the grade is equal or higher than 3.

RECOVERY:

If the AC is not passed (grades in each partial < 3 or AC grade < 5 points) the student will have to take the final test (FP) of recovery. He/she will be able to take a recovery/improvement of the grade of the 1st partial exam, one of the 2n partial exam or both.

There will not be a recovery/2nd call for re-submission of the work and exercises/problems. The mark obtained in the continuous assessment phase will be the final mark.

Students who have passed the CA may also take any of the 2 parts of the FP to improve their final mark.

Grade for the 1st partx 0.35 + Grade for the 2nd part x 0.35 + Grade for the practical work x 0.25 + Grade for problems/exercises x 0.05 (with the aforementioned particularities). In this calculation, the best mark obtained in each of the mid-term exams will always be taken.

SINGLE ASSESSMENT (AU):

Final synthesis test in which all the contents of the subject can be included, similar to the sum of the subjects of the 1st + 2nd partial of AC.

It will take place on the same date as the second partial exam of the continuous assessment.

On this date and after finishing the exam, the students will have to hand in the same exercises, works or dossiers that have been established as compulsory for the students of the continuous assessment. A mark of 5 or more will be required to pass the exam.

FINAL MARK FOR SINGLE ASSESSMENT (AU):

Exam mark x 0,70 + Practical work mark x 0,25 + problems/exercises mark x 0.05

RECOVERY FOR SINGLE ASSESSMENT (RAU):

Final synthesis test in which all the contents of the subject can be included, similar to the sum of the topics of the 1st + 2nd partial of AC. It will take place on the same day as the AC recovery.

Bibliography

Bibliography:

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Appelo, C.A.J., and Postma, D., 2005. Geochemistry, Groundwater and Pollution (2nd ed.). CRC Press, 536 pp.

De Vivo B., Belkin., Lima A., 2008. Environmental geochemistry: site characterization, data analysis and case histories. Elsevier, 429 pp.

Eby, N. G., 2003. Principles of Environmental Geochemistry. Academic Press, Amsterdam, 514 pp.

Harrison, R. M., 2004. El medio ambiente. Introducción a la química mediambiental y a la contaminación. Acribia, Editorial, S.A., Zaragoza, 490 pp.

Walter, J.V., 2005. Essentials of geochemistry. Jones and Bartlett Publishers, Boston, 704 pp.

Zhou, C., and Anderson, G., 2002. Environmental Applications of Geochemical Modeling. Cambridge University Press, 284 pp.

Software

No specific software is required.

Language list

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	1	Catalan	first semester	morning-mixed
(SEM) Seminars	1	Catalan	first semester	morning-mixed
(TE) Theory	1	Catalan	first semester	morning-mixed