Universitat Autònoma de Barcelona

2021/2022

Environmental Geochemistry

Code: 101068
ECTS Credits: 6

Degree	Type	Year	Semester
2500254 Geology	OT	3	0
2500254 Geology	OT	4	0

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

Name: Joan Reche Estrada
Email: Joan.Reche@uab.cat

Use of Languages

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

Teachers

Joan Reche Estrada

Prerequisites

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

Objectives and Contextualisation

- To know and interpret the main physico-chemical processes that regulate the distribution and mobility of geochemical elements.
- Recognize geochemical anomalies and relate them to the geological environment.
- Provide tools to identify and interpret environmental problems.
- Develop systems for research and evaluation of geochemical problems at the environmental level.
- Identify possible action strategies.
- Prepare and develop solutions to geochemical environmental problems.
- Know the 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. Outlines on the basic geochemistry needed for the solution of the main Geochemical-Environmental challenges in the three main geochemical environments:

- Geochemical environment of the atmosphere: composition, geological and biological sources, urban atmosphere, acid rain, ozone layer.
- Geochemical environment of the continents: heavy metals in sediments and waters; acid mine drainage; radioactive contamination; eutrophication of water; hydrocarbons in waters and organisms; pesticides.
- Geochemical environment of the oceans: effects of major and minor components; salinization.

2. Mineralogy and geochemistry of pollutants: mobility and dispersion of substances in the exogenous cycle. Physico-chemical processes of the environment and their characteristics. The geochemistry of these processes in different environments: mining, industrial environment, the interactions between water and minerals in rivers and lakes, or in relation to the urban atmosphere.

3. Soil pollution processes. Heavy metal pollution. Contamination by hydrocarbons and other organic compounds. Acid rain pollution. Pollution from mining activities. Remediation techniques for contaminated soils.

4. Water pollution. Basic concepts of hydrogeochemistry. Natural composition of water. Water quality. Surface and groundwater pollution. Contaminants. Contamination by acid mine drainage of river courses. Passive remediation techniques for acid mine drainage.

5. Atmospheric pollution: atmospheric particulate matter and its environmental control. Basic concepts. Aerosol sources. Particle size distribution. Nucleation and growth. Natural and anthropogenic particles.

6. Sampling in environmental geochemistry; application to soils, water, gas, geobotany and biogeochemistry. Sampling strategies.

7. Minerals, metals, gases and human and environmental health. Heavy metals. Minerals of interest in the control of environmental processes: use of geochemistry in environmental applications. Production, management and storage of geochemical waste.

8. Legislation and regulations relating to environmental geochemistry.

Practicals / Exercices / Problems (can verse on any of the 9 following topics or others related):

- Basic concepts in Environmental Geochemistry regarding the three main environments
- Problems about pollution cases
- Problems about sampling
- Erosion and chemical balance in carbonated species
- Soil-water equilibria
- Measurement of hydrochemical parameters in natural waters.
- Introduction to the application of geochemical modeling of water in Environmental Geochemistry. Case study.
- Introduction to Statistics applied to Environmental Geochemistry using the software R. Case study.
- Introduction to Geochemical Modeling. Case study.

Seminar (on the following topic or others related):

- The work of the geologist in environmental geochemistry. Case study.

Methodology

Master classes

Through the attendance to the classes the students acquire the own scientific knowledge of the asignatura and that will have to complete with the study of the subjects explained.

Practices in the classroom and / or computer laboratory

The main objective of the practical work is to encourage a more participatory and individualized teaching, promoting the scientific method and the critical spirit. The practical works will allow the student to evaluate and solve environmental problems. Real cases will be analyzed.

Seminars

These are sessions where the theoretical-practical aspects taught in the master classes are reinforced, which allow theoretical aspects to be worked on by applying them to specific cases.

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			
Master classes	26	1.04	10, 1, 9, 2, 6, 3
Practices / Problems / Exercises	15	0.6	10, 7, 5, 6, 8
Seminars	10	0.4	1, 9, 2

Type: Autonomous			
Study of topics and carrying out exercises using specific programs and the recommended bibliography.	81	3.24	10, 7, 1, 9, 6, 3, 8

Assessment

In this subject the competences and theoretical-practical abilities will be evaluated by means of CONTINUOUS EVALUATION (AC) following the following guidelines:

EXAMS:

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

A minimum grade of 3 in each midterm exam will be required to obtain an AC grade. The partials with a grade lower than 3 must be recovered in the final test.

WORK IN GROUP:

Professors can order the Delivery of a work on an assigned topic: 15% of the grade. The work will be delivered in written format and in electronic format (pdf). The work must respect the rules (script, format) specified by the teachers, especially the rules of proper accreditation of all material used. In case of not clarifying the origin of all the material used, the work will automatically receive the qualification of 0 points.

PROBLEMS / EXERCISES / WORK ON PRACTICES

Problems / exercises to be delivered: up to 15% of the grade.

Submission to 35% of the CA implies that the grade cannot be "Non assessed / submitted".

CONTINUOUS EVALUATION:

The final grade AC will be calculated as follows: 1st exam x 0.35 + 2nd exam x 0.35 + Work in group x 0.15 + Problems graded / exercises x 0.15* (weight of work and/or exercices is maximum 0.15 depending on the final ordered items)

The AC grade will only be calculated if in both exams grade is equal to or greater than 3.

RECOVERY:

If the AC is not passed (Notes in each partial <3 or AC note <5 points) the student must submit to a final exam (PF) of recovery. He will be able to present to a recovery / improvement of note of the 1st partial examination, one of the second partial examination or to both.

There will be no resumption / 2nd call for new assignment of work and exercises / problems. The mark obtained in the continuous evaluation phase will be the final one.

Students who have passedthe AC, may also apply to any of the 2 parts of the PF to improve their final grade.

Once the PF has been done, the final grade will be calculated as follows: Grade of the 1st part x 0.35 + Grade of the 2nd part x 0.35 + Grade of the work x 0.15 + Grade of Problems / exercises x 0.15. In this calculation the best mark obtained in each of the partials will always be taken.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes

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

Bibliography

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

HARRISON, R. M. Ed., 2004. *El medio ambiente. Introducción a la química medioambiental y a la contaminación*. Acribia, S.A., Zaragoza.

LANGMUIR,D., 1997. *Aqueous Environmental Geochemistry*. Prentice Hall, Upper Saddle River, 600 pp.

WALTHER , J.V., (2005). *Essentials of geochemistry.* Jones and Bartlett Publishers , Boston, 704 pp.

ZHU, C., 2002. *Environmental Applications of Geochemical Models,* Cambridge Univ. Press, Cambridge, 248pp.

ALBARÈDE, F.,1995. *Introdution to Geochemical Modeling*. Cambridge Univ. Press, Cambridge, 543 pp.

APPELO, C.A.J. & POSTMA, D.,1996 (3º Ed). *Geochemistry, groundwater and pollution*.A.A. Balkema, Rotterdam, 536 pp.

DE VIVO B., BELKIN H.E., LIMA A. (2008).Environmental geochemistry: site characterization, data analysis and case histories.Elsevier, 429pp.

Software

No specific software is required.