

26420 - Geochemistry

Syllabus Information

Academic Year: 2022/23

Subject: 26420 - Geochemistry

Faculty / School: 100 - Facultad de Ciencias

Degree: 296 - Degree in Geology

588 - Degree in Geology

ECTS: 7.0

Year: 3

Semester: First semester

Subject Type: Compulsory

Module:

1. General information

1.1. Aims of the course

This course is designed to provide a broad introduction to Geochemistry and to the use of geochemical concepts and methods to solve geological problems. It includes the study of: factors controlling the abundance and distribution of elements in the Earth and Solar System; the chemical behaviour of different classes of elements in high and low temperature geological processes; and the analytical techniques and data processing methods used to solve different geological problems. Throughout the course, the interconnections between Geochemistry and other fields in the geological sciences are explored. The course includes an important content of practical sessions.

These objectives are in the line of the following Sustainable Development Goals of the UN 2030 Agenda (<https://www.un.org/sustainabledevelopment/>), in such a way that the acquisition of the knowledge given in this course provides the ability and competence to contribute to their achievement:

- SDG 4: Quality Education

1.2. Context and importance of this course in the degree

Throughout the course, the interconnections between Geochemistry and other fields in the geological sciences are explored.

1.3. Recommendations to take this course

It is recommended to have taken (and passed) the compulsory courses of Chemistry, Physics, Mathematics, Statistical Treatment of Geologic Data, Mineralogy, Hydrogeology and Sedimentary Petrology in the first and second courses of the degree.

It is also suggested to have a continuous working plan with constant review of the theoretical and practical concepts and to use the resources indicated by the teachers in terms of web pages and academic tuition.

2. Learning goals

2.1. Competences

Upon successful completion of this course, students will be able to:

- Understand and apply the concepts and methods of Geochemistry.
- Demonstrate an adequate understanding of the most important analytical methods and common practical data handling in Geochemistry.
- Effectively express themselves in written and oral form on topics dealing with geochemical and geological problems.

2.2. Learning goals

The student, to pass the course, should be able to...

- Explain and use in a clear and precise way the basic concepts of Geochemistry.
- Relate the compositional characteristics of a geological system to the factors, variables and processes that have shaped it.
- Select the best suited analytical techniques for the study of geological samples, given a specific geological problem.
- Use the quantitative methodologies specific to Geochemistry to explore and analyse field and laboratory data, including the basics of geochemical modelling.

2.3. Importance of learning goals

Geochemistry is one of the core disciplines in the Earth Sciences, being also multidisciplinary and transversal.

Thus, geochemical techniques, concepts and methodologies are frequently used in other geological disciplines as Mineralogy, Petrology, Hydrogeology, Stratigraphy, Geomorphology or Paleontology. On the other hand, the geochemical nature of many environmental problems (pollution, global warming, disposal of wastes or CO₂, etc.) has triggered a fast increase in the use of Geochemistry in the past decade. This widespread use of Geochemistry is also related to its quantitative approach and predictive power.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

In this course there are two forms of assessment: continuous assessment and end-of-term examination.

Continuous assessment

Student performance will be evaluated on the basis of theory quizzes and practical exercises at the end of each lecture block. Final grades for this assessment will be based on the following: theory quizzes (50% of the final grade); practical exercises (50% of the final grade).

End-of-term examination

Students who do not opt for the continuous assessment, or who do not pass the continuous assessment, shall attend the End-of-term Examination, which consists of two parts:

- A theory test on topics addressed during the course (this test will include multiple-choice questions, true/false questions and short answer questions).
- A practical exercise on topics addressed in the problem classes.

Final grade for this assessment will be as follows: theory test (50% of the final grade) and practical exercise (50% of the final grade).

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, practice sessions and assessment tasks.

This course is designed to provide a broad introduction to Geochemistry by presenting the key geochemical concepts and methods needed to solve geological problems. The student will develop competences in the application of the basic principles of chemistry to the Earth, including factors controlling the abundance and distribution of chemical elements in the Earth and the Solar system, the behaviour of elements during the geological processes, and geochemical methodologies to solve geological problems.

Classroom materials will be available via Moodle. These include a repository of the lecture notes used in class, the course syllabus, as well as other course-specific learning materials, including a discussion forum.

Further information regarding the course will be provided on the first day of class.

4.2. Learning tasks

The course includes the following learning tasks:

- **Learning task 1 ? Lectures** (2.5 ECTS). Development of the concepts and theoretical basis of the course. 25 lectures of one-hour sessions.
- **Learning task 2 - Practical Sessions** (4.5 ECTS). Computer-oriented and/or problem-solving classes organised into two-hour sessions taking place twice per week. Students are provided in advance with lab handouts for each session, available through the Moodle page of the course.

Note: The approach, methodology and evaluation indicated in this guide are prepared to be the same under any teaching

scenario. They will be adjusted to the socio-sanitary conditions at any time, as well as to the instructions given by the competent authorities

4.3. Syllabus

The course consists of four parts: fundamentals and methods; geochemistry of exogenous processes; geochemistry of endogenous processes; cosmochemistry and geochemistry of the solid earth.

Part I. Fundamentals and Methods

- Lecture 0. Introduction.
- Lecture 1. Geochemical classifications of the elements.
- Lecture 2. Isotope Geochemistry. Radiogenic isotopes.
- Lecture 3. Isotope Geochemistry. Stable isotopes

Part II. Geochemistry of exogenous processes

- Lecture 4. Water-rock-gas interactions. Basic concepts.
- Lecture 5. Aqueous geochemistry. Speciation.
- Lecture 6. Geochemistry of sedimentary rocks.
- Lecture 7. Geochemical exploration. Principles and applications.

Part III. Geochemistry of endogenous processes

- Lecture 8. Behaviour of trace elements in endogenous processes.
- Lecture 9. Spider diagrams and other multi-element diagrams.
- Lecture 10. Hydrothermal processes.

Part IV. Cosmochemistry and geochemistry of the solid earth

- Lecture 11. Cosmochemistry.
- Lecture 12. Origin and differentiation of the Earth.
- Lecture 13. Geospheres.

Practicals

This course includes computer-aided problem classes.

Six sessions dedicated to problems on the geochemical classifications of the elements and isotopic geochemistry

- Eight sessions dedicated to problems on low temperature geochemistry.
- Four sessions dedicated to problems on high temperature geochemistry.
- Four sessions dedicated to problems on cosmochemistry and earth differentiation.

4.4. Course planning and calendar

- 7 ECTS:
 - Hours of lectures: 25
 - Hours of Practice/Problem solving classes: 45
 - Hours of assessment: 7
 - Hours of autonomous work: 98

Total hours: 175

Classes will start at the beginning of the second semester following the academic calendar of the Sciences Faculty.

4.5. Bibliography and recommended resources

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=26420>