UAB
Universitat Autònoma de Barcelona

Mineralogy

Code: 101058
ECTS Credits: 10

2024/2025

Degree	Type	Year
2500254 Geology	OB	2

Contact

Name: Dídac Navarro Ciurana

Email: didac.navarro@uab.cat

Teachers

Maria Merce Corbella Cordomi

Lluis Casas Duocastella

Isaac Corral Calleja

Teaching groups languages

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

Prerequisites

Fundamentals of Geology knowledge (1st year of the Geology Degree) is required, of special relevance are the acquired knowledge of Crystallography and Chemistry.

Objectives and Contextualisation

- To understand the concept of mineral and the main mechanisms of mineral formation.
- To know the basic terminology in mineralogy.
- To know the characteristics of the main o most important mineral groups.
- To understand the relationship between crystal structure, mineral chemistry, mineral stability, and the physical, chemical, and optical properties of minerals.
- To know and apply the basic methodology in mineralogical studies.
- To learn how to determine the minerals' structural formula from chemical analyses.
- To know how to use the mineral's properties for their identification and classification in hand specimen, as well as in transmitted light microscopy.
- To recognize the main rock-forming minerals in hand specimen, as well as in transmitted light microscopy.

Competences

- Draw up and interpret geological maps and other means of depicting geological information (columns, correlation frames, geological cross-sections, etc.)
- Identify and characterise minerals and rocks through instrumental techniques, determine their formation environments and know their industrial applications.
- 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.
- Relate the physical properties of matter to its structure.
- Show an interest in quality and incorporate it into practice.
- Work in teams, developing the social skills needed for this.
- Work independently.

Learning Outcomes

1. Calculate mineral formulae from their composition.
2. Learn and apply the knowledge acquired, and use it to solve problems.
3. Present arguments based on phase diagrams.
4. Recognise rock-forming minerals and the principal ores in hand specimen and using a petrographic microscope.
5. Relate field observations of minerals and rocks to laboratory observations and to genetic theory, based on the textures.
6. Relate the physical properties of matter to its structure.
7. Show an interest in quality and incorporate it into practice.
8. Work in teams, developing the social skills needed for this.
9. Work independently.

Content

Block 1. Basic concepts of mineralogy, mineral classification and mineral formation

Unit 1. Introduction: Definition of mineral. Economic importance. Classification and nomenclature of minerals. Mineral genesis. Formational environments.

Block 2. Crystallochemistry and crystallophysics: Structure, properties, and mineral analytical techniques

Unit 2. Crystallochemistry: Chemical elements, bonds, atomic radius, coordination. Most important structural types in mineralogy. Pauling's Rules. Spatial symmetry.

Unit 3. Crystallographic morphology: Crystal growth. Crystal habit. Twinning. Polymorphism. Isomorphism. Crystal defects. Basics of X-ray diffraction and X-ray fluorescence.

Unit 4. Physical properties of minerals: Cleavage and fracture, hardness, color, streak, luster. Luminescence. Piezo and pyroelectricity.

Unit 5. Optical properties of minerals: Light and waves. Refractive index. Petrographic microscope. Polarizer and birefringence. Optical indicatrix, uniaxial and biaxial crystals. Pleochroism.

Unit 6. Mineral chemistry: Analytical techniques. Graphical representation of mineral composition. Structural formula determination. Mineral stability.

Block 3. Systematic description of minerals

Unit 7. Silicates: Introduction and classification of silicates.

Unit 8. Tectosilicates: Structure and properties. Silica group, feldspars, feldspathoids, and zeolites.

Unit 9. Phyllosilicates: Structure and properties. Mica, chlorite, and serpentine groups. Clay minerals.

Unit 10. Inosilicates: Pyroxenes, pyroxenoids, and amphiboles. Properties derived from the structure.

Unit 11. Sorosilicates, Cyclosilicates, and Nesosilicates: Epidote group. Beryl, cordierite, and tourmaline. Olivine, garnet, and aluminosilicate groups.

Unit 12. Carbonates, Borates, Sulfates, Tungstates, Molybdates, Phosphates, Arsenates, and Vanadates.

Unit 13. Oxides, Hydroxides, and Halides.

Unit 14. Native elements, Sulfides, and Sulfosalts.

Hand sample mineral identification practices

Block 1. Properties of minerals in hand specimen: optical properties (color, patina, streak color, luster), mechanical properties (cleavage, hardness, density, tenacity), crystallographic properties (facets, habit, twinning, aggregates), and other properties (magnetism, feel, radioactivity, and luminescence).

Block 2. Mineral identification in hand specimens: Minerals with metallic, semi-metallic, and vitreous luster. Alteration minerals.

Transmitted light microscope mineral identification practices

Block 3. Properties of minerals in transmitted light microscopy: polarized light (color, pleochroism, shape, habit, cleavage, fractures, alterations), polarized + analyzed light (isotropy/anisotropy, interference colors, extinction, twinning, zoning, and exsolution), and convergent light (interference figures and optical signs).

Block 4. Mineral identification under transmitted light microscopy: Carbonates and tectosilicates. Phyllosilicates. Inosilicates. Nesosilicates. Sulphates. Accessory minerals.

Field practices

One day of fieldwork will be carried out in outcrops and dumps of inactive mines. Recognition of geological and lithological characteristics of the area. Identification of mineralization and its relationship with geological structures. Recognition of metallic and vitreous minerals in hand specimen, as well as their associated supergene alterations. Identification of the paragenetic sequence and its relationship with the geological history of the area.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Field work	7	0.28	2, 5
Practical classes	38	1.52	4, 5, 7, 8, 9
Theoretical classes	39	1.56	1, 2, 3, 6, 9
Type: Supervised			
Group tutory	6.5	0.26	8
Type: Autonomous			
Study and tasks	147.5	5.9	2, 7, 8, 9

The course methodology consists of:

1. Lectures of 50 minutes each are programmed. The basic concepts will be provided, as well as the necessary information to understand their content. Lecturers will provide the graphic material used in the sessions through the Virtual Campus.
2. Practical sessions of 110 minutes each are programmed in the Microscopy Lab (C2/-160.1). The practical sessions are divided into two parts: 1) an initial one where mineral recognition in hand specimens through their properties, and 2) a final one where a transmitted light microscope will be used to identify the main rock-forming minerals. Lecturers will provide a practice guide, identification tables, and presentations on the Virtual Campus in order to facilitate the learning process.
3. A one-day field trip to recognize minerals and mineral associations in nature and to comprehend their genesis.
4. Autonomous student work. Various problems, exercises, and virtual tests will be provided, as well as visual material (e.g., a mobile application for viewing minerals under a microscope, Minescope) to autonomous learning.

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
Practical Exams (4 + field exam)	50% of the final mark	6	0.24	2, 4, 5, 7, 8, 9
Theoretical exams: 4 parts	50% of the final mark	6	0.24	1, 2, 3, 6, 7, 9

The competences and knowledge acquired in the lectures and practical sessions will be evaluated separately.

Lectures: 4 partial exams will be conducted, which can be retaken or improved for a higher grade. It is necessary to obtain a minimum of 3.5 out of 10 in each exam to average the grade. The evaluation will be as follows:

- 1st exam. Topics 1 to 3 (Introduction, Crystal Chemistry, and Crystal Morphology). 30% of the total theory grade.
- 2nd exam. Topics 4 and 5 (Physical and Optical Properties). 20% of the total theory grade.
- 3rd exam. Topic 6 (Mineral Chemistry, structural formulas). 15% of the total theory grade.
- 4th exam. Topics 7 to 14 (Systematic description). 35% of the total theory grade.

The final re-taking or improvement exam is programmed by the Faculty and advertised in its web page.

Practices: 4 exams will be conducted at the end of each practical block. It is necessary to obtain a minimum of 3.5 out of 10 in each exam to average the grade. The evaluation will be as follows:

- 1st exam. Block 1 of practices (Properties of minerals in hand specimens). 10% of the total practice grade.
- 2nd exam. Block 2 of practices (Mineral identification in hand specimens). 30% of the total practice grade.

- 3rd exam. Block 3 of practices (Properties of minerals under a transmitted light microscope). 15% of the total practice grade.
- 4th exam. Block 4 of practices (Mineral identification under a transmitted light microscope). 35% of the total practice grade.

All these exams could be re-taken on the date indicated by the teachers at the end of all practical sessions.

Fieldtrip: One exam will be conducted at the end of the fieldtrip. It accounts for 10% of the final grade, which will be averaged with the completed laboratory practices grade.

The final grade of the course will be calculated considering the average of the theory grades (50%) and the practices and fieldwork together (50%). The course will be passed with a minimum average of 5 out of 10 points. It will be mandatory to attend the field trip and 60% of the practical sessions.

Single evaluation

In the event that a student requests a single subject assessment (in the form and date determined by the Faculty), he/she will take an exam consisting in a theory test (50%), a practical test of mineral recognition in hand samples and under the microscope, with oral correction (40% mark) and a field test (10%). The date of this exam will be that of the last theory exam of the subject. It will be mandatory to attend the field trip and 60% of the practical sessions. The same recovery system will be applied as for continuous evaluation. The review of the final qualification follows the same procedure as for continuous evaluation.

Bibliography

Highly Recommended Books

KLEIN, C., HURLBUT, C.S. (1999). Manual de Mineralogía: Basado en la obra de J.D. Dana (Cuarta edición). Wiley. Description: Highly recommended book, simple and comprehensive, for the theoretical part of the subject. It consists of 2 volumes. The first volume is very suitable to complement Units 1 to 6. The second volume is ideal for complementing the topics of Block 3 "Systematic Description of Minerals" (Units 7 to 14). It includes good descriptions of hand specimen minerals and the classification used is very up-to-date. The fourth edition in Spanish should be used, as some older editions have translation errors.

MACKENZIE, W.S., GIILFORD, C. (1980). Atlas of rock forming minerals in thin section. Harlow, Essex: Longman. Description: A classic in the identification of minerals under transmitted light microscopy. This book has many photographs and little text.

MATA, J.M. (1988). Guia d'identificació de minerals. Parcir. Manresa. Description: This book offers systematic tables for mineral identification. This guide includes photographs of minerals found in the field. It does not contain photographs of spectacular crystals, as most mineralogical guides do, since it aims to help students identify minerals as they are commonly found in nature.

Recommended Books

BLOSS, F.D. (1994). Introducción a los métodos de Cristalografía óptica. Omega. 4. Description: This book was written specifically for students beginning the study of optical crystallography. There are no advanced technical descriptions, but you can find a complete and simple presentation of the basic techniques for determining the optical constants of crystals, using the transmitted light microscope and immersion methods.

DEER, W.A., HOWIE, R.A., ZUSSMAN, J. (1992). An introduction to the rock forming minerals. 2nd ed. Longman Scientific & Technical. Description: A general book that includes detailed descriptions of the most important rock-forming minerals. Although there is no version in Catalan or Spanish, the English version is simple and understandable.

EHLERS, E.G. (1987). Optical mineralogy. Palo Alto (Calif.): Blackwell Scientific. Description: A very good book on optical mineralogy, highly recommended for Unit 5 of the theoretical part and for mineral identification

practices using transmitted light microscopy (Blocks 3 and 4 of practices). There is no version in Catalan or Spanish.

PUTNIS, A. (1992). An Introduction to Mineral Science. Cambridge University Press. Description: This book, in English, provides an introduction to modern mineralogy for university students, as well as to mineral crystal physics and chemistry.

WENK, H-R., BULAKH, A. (2003). Minerals. Their Constitution and Origin. Cambridge University Press. Description: This book, in English, is recommended for students as it covers a wide range of topics, from mineral classification and crystal structures to mineral physics and how they form in the natural environment. It places much emphasis on linking minerals with major geological processes.

Advanced Level Books

MELGAREJO, J.C. (1997). Atles d'associacions minerals en làmina prima. Barcelona: Edicions Universitat de Barcelona: Fundació Folch. Description: An advanced level book on the identification of minerals under transmitted light optical microscopy. The first part presents introductory chapters summarizing the most important mineral groups and the most relevant geological environments in which they are found. The second part contains identification sheets for hundreds of minerals, only a portion of which are covered in the course.

Highly Recommended Websites

DA MOMMIO, A. Alex Strekeisen. [Accessed: June 11, 2024]. Available at: https://www.alexstrekeisen.it/english/index.php Description: A website designed for geology, mineralogy, and petrology students. There are a variety of photographs of minerals under optical microscopy. Minerals are presented according to the most common rock type in which they are found. Very educational and illustrative.

GIL-CRESPO, P.P. Atlas de Mineralogía Óptica. [Accessed: June 11, 2024]. Available at: https://www.ehu.eus/mineralogiaoptica/ Description: A website primarily aimed at mineralogy students, presenting supplementary teaching material for optical crystallography and mineralogy practices. There are microphotographs, videos, and 3D models. Highly recommended for blocks 3 and 4 of the practices.

GRUP MINERALÓGIC CATALÀ. MinerAtlas. [Accessed: June 10, 2024]. Available at: https://mineratlas.com/ Description: It's a geographic database (mostly of Catalonia) that allows you to locate the position of various mineral deposits. This website serves as a reference for conducting independent field trips outside of academic activities to identify and recognize minerals in the field.

RALPH, J., CHAU, I. Mineralogy database. [Accessed: June 10, 2024]. Available at: http://www.mindat.org/ Description: A very complete mineral database, with optical properties, photographs, mineral forms, chemical composition, crystal structures, locations, references, etc.

BARTHELMY,D. Mineralogy database. [Accessed: June 10, 2024]. Available at: https://webmineral.com/ Description: Website with mineral descriptions, crystal structures, and chemical analyses.

IMA. International Mineralogical Association Database of Mineral Properties. [Accessed: June 10, 2024]. Available at: https://rruff.info/ima/ Description: IMA website where nomenclatures and classifications of over 6000 rock-forming minerals can be downloaded in PDF format.

PERROUD, P. Athena Mineral database. [Accessed: June 10, 2024]. Available at: https://athena.unige.ch/athena/mineral/mineral.html Description: Website with a detailed images showcasing a wide array of minerals, offering a valuable resource for enthusiasts, researchers, and students alike.

Mobile Applications

ROQUET, M., ARASANZ, R. Minescope. [Accessed: June 10, 2024]. Available at: https://play.google.com/store/search?q=minescope&c=apps&hl=es Description: A mobile or tablet application featuring sequences of images showcasing minerals in thin section, observed through a petrographic microscope. This app encompasses the most common rock-forming minerals studied in mineralogy. Experience simulated rotation of the microscope stage and engage in interactive mineral identification by selecting their optical properties. Highly recommended for mineralogy students.

Social Networks

ALEXSTRECKEISEN. Instagram. [Accessed: June 11, 2024]. Available at: https://www.instagram.com/alexstrekeisen/ Description: This profile features a multitude of microphotographs showcasing various minerals studied in mineralogy practices. It's an ideal resource for testing your ability to identify mineral properties under optical microscopy.

Software

No specific software is necessary.

Language list

Name	Group	Language	Semester	Turn
(PCAM) Field practices	1	Catalan	annual	morning-mixed
(PCAM) Field practices	2	Catalan	annual	morning-mixed
(PLAB) Practical laboratories	1	Catalan	annual	morning-mixed
(PLAB) Practical laboratories	2	Catalan	annual	morning-mixed
(PLAB) Practical laboratories	3	Catalan	annual	morning-mixed
(PLAB) Practical laboratories	4	Catalan	annual	morning-mixed
(TE) Theory	1	Catalan	annual	morning-mixed