NAME OF COURSE

PETROLOGY

MODULE	MATERIAL	COURSE	SEMESTER	CREDITS	TYPE
Geological materials and processes	Petrology	3rd	1st	6	Compulsory

PROFESSORS	CONTACT ADDRESS FOR TUTORIALS (postal address, telephone, email, etc ...)
• Fernando Bea Barredo (FB). Full professor • Jane H. Scarrow (JHS). Lecturer • Antonio García Casco (AGC). Full professor • Concepción Lázaro Calisalvo (CLC). Assistant lecturer	Mineralogy and Petrology Department 1st floor, Faculty of Sciences. Offices nª 15A, 15D, 15C, and 3, second floor, office ... Emails: fbea@ugr.es, jscarrow@ugr.es, agcasco@ugr.es y clazaro@ugr.es
	TUTORIAL HOURS
	Mondays and Wednesdays, from 15 to 18 (FB) Mondays, Tuesdays and Wednesdays, from 13 to 15 (virtual from 14 to 15) (JHS, CLC) Mondays, Tuesdays and Wednesdays, from 13 to 15 (AGC)

DEGREE IN WHICH COURSE IS GIVEN	OTHER DEGREES TO WHICH IT COULD BE OFFERED
Geology	

PREREQUISITES AND RECOMMENDATIONS (if necessary)
To have taken Mineralogy
BRIEF DESCRIPTION OF COURSE CONTENT
Igneous Petrology

Basic concepts. Mineralogy, classification, form and structure of igneous rocks.
Physical-chemical characteristics. Magma generation and differentiation. Igneous rock series and tectonomagmatic associations. Calculation of the CIPW norm. Use of classification diagrams. Microscope study of igneous rocks.

Metamorphic Petrology
Basic concepts. Mineral associations and classification of metamorphic rocks.
Metamorphism of different rock types. Graphic and microscope study of metamorphic associations.

SPECIFIC AND GENERAL COMPETENCES

Capability to think reflexively
Written and oral communication skills
Mineral, rock and rock association recognition and interpretation. Rock generation processes and temporal controls. Be able to correlate data and interpret results.
Know how to identify fossils and how to use them to interpret and date ancient sedimentary material. Know how to recognize geomorphological systems and how to interpret surface landforms.
Recognize, represent and reconstruct tectonic structures and the processes that generate them. Know how to correlate rock characteristics and petrogenetic processes. Know how to relate rocks with their geodynamic environment.
Prepare, process and interpret data qualitatively and quantitatively and use appropriate software.

OBJECTIVES (EXPRESSED AS DESIRED RESULTS OF THE TEACHING)

The final and fundamental objective of Geology is to study planet Earth.: know its origin, it's evolution, it's resources and the interaction between physical, chemical and biological environmental processes during its history. Advances in disciplines such as Astronomy, Astrophysics and, recently, Geobiology has permitted the expansion of geological study to the rest of the planets in the Solar System.
With these objectives in mind, the Geology degree has two main aims in training students. On the one hand, the first aim is to give the students sound basic knowledge, skills and abilities of the degree and related subjects. Enabling problem resolution by applying the acquired knowledge. On the other hand, the second main aim is to prepare the student to enter the labour market as professionals. With theses basic objectives scientific and professional expectations of the Geology degree are met (both from a general and specific perspective). This guarantees fundamental student rights, non-discriminatory equal opportunities and and cultural values of peace and democracy.
In this context of broad objectives, it is possible to specify the following general objectives:
1.- Transmit knowledge, capabilities and abilities to facilitate the easy, rapid and efficient resolution of geological problems.

2.- Understand nature and know the relevant methods for geological study with a historical perspective.

3.- Prepare professionals with capabilities and aptitudes relevant for the labour market and the needs of society.

4.- Provide the student with the essential tools to work in a geological context.

5.- Facilitate access to information related to the degree.

6.- Give the students a perspective of caring for the environment and protecting natural resources.

These general objectives are applied more specifically in Petrology by introducing the student to the theoretical and practical study of igneous and metamorphic rocks. For the identification and classification of both rock types, identification of their main minerals is essential as is an understanding of the relationships between them (for classification). Using this information in a petrological study can lead to a deeper understanding of petrological processes.

DETAILEDCOURSE CONTENT

THEORY CONTENT

PART I: Igneous Petrology

Theme 1. Introduction to Petrology
Introduction: why do we study igneous rocks ?
Petrographic nomenclature of igneous rocks
Geochemical nomenclature of igneous rocks

Theme 2.Ultramafic rocks
Introduction: nomenclature.
Style of emplacement.
Petrogenesis and tectonic context.

Theme 3. Mafic plutonic rocks
Introduction: nomenclature.
Style of emplacement.
Petrogenesis and tectonic context.

Theme 4. Mafic volcanic rocks
Introduction: nomenclature.
Style of emplacement.
Petrogenesis and tectonic context.

Theme 5. Intermediate and acid plutonic rocks
Introduction: nomenclature.
Style of emplacement.
Petrogenesis and tectonic context.

Theme 6. Intermediate and acid volcanic rocks
Introduction: nomenclature.
Style of emplacement.
Petrogenesis and tectonic context.

Theme 7. Alkaline rocks
Introduction: nomenclature.
Style of emplacement.
Petrogenesis and tectonic context.

PART II: Metamorphic Petrology

Theme 8: Metamorphism - definition and geological context
Definitions, variables and conditions of metamorphism.
Types of metamorphism.
Protoliths and metamorphic rock compositional groups.
Mineral associations and paragenesis. Prograde, peak and retrograde mineral associations.

Theme 9. Metamorphic processes
Physical-chemical principles of metamorphic processes.
Phase diagrams. Compositional projections, petrogenetic networks and pseudosections.
Metamorphic intensity

Theme 10. Metamorphism of ultramafic rocks
Rock types, chemical and mineralogical compositions.
Metamorphic associations of the MSH system (metaharzburgite).
Metamorphic associations of the CMSH system (metalherzolite).
Upper mantle, CMASH system, metamorphic facies.

Theme 11. Metamorphism of carbonate rocks
Rock types, chemical and mineralogical compositions.
Metamorphic associations of the CMSHC system.
Effects of fluid phase composition in metamorphism of carbonate rocks.
Impure carbonates: metamorphic evolution for internally and externally controlled fluid phase compositions.

Theme 12. Metamorphism of pelitic rocks and gneisses.
Rock types, chemical and mineralogical compositions.
Metamorphic associations of the KFMASH system.
Intermediate, low and high pressure zone sequences.
Partial fusion of metapelites and gneisses.

Theme 13. Metamorphism of mafic rocks.
Rock types, chemical and mineralogical compositions.
Metamorphic associations of the NCF2+MF3+ASH system.
Very low grade, intermediate, low and high pressure metabasites.

Theme 14.
Dating metamorphic events and reconstruction of P-T-t trajectories.
Metamorphism and continental collision.
Metamorphism and subduction zones.
Metamorphism and volcanic arcs.
Metamorphism and ocean spreading centres.

PRACTICAL CONTENT
Seminars
S1. Calculation of the CIPW norm.
S2. Description and classification of igneous rocks.
S3. Classification and nomenclature of metamorphic rocks.
S4. Criteria for identification of equilibrium mineral associations. The relationships between blastesis, deformation and other textural criteria for ordering metamorphic mineral associations.

Practical classes
Ultramafic igneous rocks.
Mafic igneous rocks.
Intermediate igneous rocks.
Acid igneous rocks.
Alkaline igneous rocks.
Ultrabasic composition metamorphic rocks (Metaultramafites).
Carbonate composition metamorphic rocks (Metacarbonates).
Pelitic composition metamorphic rocks I (Metapelites and gneisses).
Pelitic composition metamorphic rocks II (Metapelites and gneisses). Basic composition metamorphic rocks I (Metabasites).
Basic composition metamorphic rocks II (Metabasites).

BIBLIOGRAPHY

BASIC BIBLIOGRAPHY

- Bard, J.P., 1987, *Microtexturas de rocas magmáticas y metamórficas*. Masson.
- Bucher, K. & Grapes, R., 2011, *Petrogenesis of metamorphic rocks*. Springer-Verlag.
- Gill R., 2010, *Igneous rocks and processes: A practical guide*. Wiley-Blackwell.
- MacKenzie, W.S., Donaldson, C.H., Guilford, C., 1982, *Atlas de rocas ígneas y sus texturas*. Masson, Barcelona.
- MacKenzie, W.S., Guilford, C., Yardley, B.W.D., 1990, *Atlas of metamorphic rocks and their textures*. Longman.

COMPLEMENTARY BIBLIOGRAPHY

- Spear, F.S., 1993, *Metamorphic phase equilibria and pressure-temperature-time paths*. Min. Soc. Am. Monographs.
- Cox, K.G., Bell, J.D., Pankhurst, R.J., *The interpretation of Igneous Rocks*. George Allen & Unwin.
- Hughes, C.J., 1982. *Igneous Petrology*. Elsevier.
- MacKenzie, W.S., Adams, A.E., 1997, *Atlas en color de rocas y minerales en lámina delgada*. Masson, Barcelona.
- Yardley, B.W.D., 1989, *An Introduction to metamorphic petrology*. Longman.

RECOMMENDEDLINKS

http://www.ugr.es/~agcasco/personal/ , http://www.ugr.es/~petgquim/P1web.html , http://www.naturascope.com

TEACHINGMETHODS

- Theory classes: 3 ECTS
- Practical classes (including microscope work and problems)
- Tutorials (individuals and in groups)
- Seminars and literature study (individual and in groups, including preparation and presentation of a report).

ACTIVITIESPROGRAM

FIRST SEMESTER	THEORY CONTENT	CLASSROOMACTIVITIES(60 hours)						PERSONALSTUDYACTIVITIES(90 hours)			
		THEORY SESSIONS (HOURS)	PRACTICAL SESSIONS (HOURS)	SEMINARS AND PRESENTATIONS (HOURS)				INDIVIDUAL TUTORIALS (VIRTUAL-SWAD) AND GROUP TUTORIALS (HOURS)	STUDENT STUDY AND INDIVIDUAL WORK (HOURS)	GROUP WORK (HOURS)	Etc.
WEEK1	1	3		2 (S1)				3	2	1	
WEEK 2	2	3		2(S2)				3	2	1	
WEEK 3	3	3	2					3	2	1	
WEEK 4	4	3	2					3	2	1	
WEEK 5	5	3	2					3	2	1	
WEEK 6	6	3	2					3	2	1	
WEEK 7	7	3	2					3	2	1	
WEEK 8	8,	3		2 (S3)				3	2	1	
WEEK 9	9	3		2 (S4)				3	2	1	
WEEK10	10	3	2					3	2	1	
WEEK11	11	3	2					3	2	1	
WEEK12	12	3	2					3	2	1	
WEEK13	13	3	2					3	2	1	
WEEK14	14	3	2					3	2	1	
WEEK15											
Total hours		42	20	8				42	28	14	

EVALUATION(TOOLS, CRITERIAAND FINALPERCENTAGES, ETC.)

EVALUATION TOOLS

Tests (written examinations).

Auto-evaluation and peer-evaluation tests.

Presentation of reports (practical sessions introductions).
Analysis of individual and group work content (reports, practical workbooks, etc).

EVALUATION CRITERIA
Determination of knowledge and application of theory and practical course content.
Evaluation of group and individual reports, based on the quality of presentation, elaboration, clarity of ideas, structure, scientific ideas, creativity, justification of conclusions, critical reasoning and bibliography consulted.
Assessment of student attitude and level of participation in class, group work, seminars and tutorials.
Record of class, seminar, conference, tutorial and group work attendance.

FINAL MARK
The final mark is made up of the results in the written examinations (theory, 60%, and practical, 40%) 60%, auto- and peer-evaluations 5%, presentation of reports 5%, individual and group work material 30%. The additional percentages will be added to the mark of the final written examinations when this is at least 4/10. If a student passes one of the two parts of the course (theory or practical) the grade will be kept until the September exam of the same academic year.

ADDITIONAL INFORMATION