

Geological Mapping

Code: 101040
ECTS Credits: 10

Degree	Type	Year	Semester
2500254 Geology	FB	2	A

Contact

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Use of Languages

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

Teachers

David Manuel Gómez Gras
Enric Vicens Batet
Joan Escuer Solé
Marta Roige Taribo
Eloi Carola Molas
Eduard Saura Parramon
Albert Grieria Artigas

Prerequisites

To take this course, it is recommended that the students have passed the course "Fonaments de Geologia" and they have basic knowledge on:

- description of rocks and outcrops.
- the main tectonic structures: folds and faults.
- the main concepts related with the evolution of the geological history of a region: sedimentation, deformation, igneous intrusions, erosion and unconformities.

A basic skill in the geological cartography is the interpretation of geological bodies in three-dimension. For this reason, the students are recommended to use the digital resources given in the bibliography to practise this competence.

Objectives and Contextualisation

This course is a basic subject and part of the block called "Geology" of the Bachelor's degree in Geology. The goals of the course are:

- Give to the students the basic skills to be autonomous in the field work tasks (acquisition of data, creation of stratigraphical logs and geological cross-sections).
- Provide the geometrical techniques for the understanding and interpretation of the geological structure.
- Provide the methodologies to elaborate and to interpret geological maps and cross-sections.

In order to acquire a good competence in Geology is essential the geological cartography course, as this provide the skills on how to perform and do the interpretation of geological maps. Both competences are basic for a geologist and useful for all geological disciplines.

On successfully completing this course, students will be (1) able to interpret geological maps of medium complexity and (2) capable to elaborate all the aspects related with field acquisition, interpretation and elaboration of a geological map.

Competences

- Display understanding of the fundamental principles of geology and the ability to identify the basic types of minerals, rocks and structures.
- Draw up and interpret geological maps and other means of depicting geological information (columns, correlation frames, geological cross-sections, etc.)
- Evaluate moral and ethical problems in research and acknowledge the need to follow professional codes of conduct.
- Learn and apply the knowledge acquired, and use it to solve problems.
- Suitably transmit information, verbally, graphically and in writing, using modern information and communication technologies.
- Synthesise and analyse information critically.
- Work in different environments and localisations, with respect for diversity and multiculturalism.
- Work in teams, developing the social skills needed for this.
- Work independently.

Learning Outcomes

1. Conduct individual fieldwork with honesty.
2. Display ethical, socially-responsible behaviour during field trips.
3. Draw up a geological map independently, based on fieldwork.
4. Interpret geological maps made by others.
5. Learn and apply the knowledge acquired, and use it to solve problems.
6. Recognise in the laboratory and in the field the principal types of rocks and structures and the most common minerals.
7. Suitably transmit information, verbally, graphically and in writing, using modern information and communication technologies.
8. Synthesise and analyse information critically.
9. Work in different environments and localisations, with respect for diversity and multiculturalism.
10. Work in teams, developing the social skills needed for this.
11. Work independently.

Content

Theory and practical contents

The course is organised in four practical blocks:

Block 1 Geometrical problems

- The geologic map. Map projection systems. Map scale. Geolocalisation in map and field: UTM and geographical coordinates.
- Determination of the orientation of a plane using geometrical techniques.
- Outline of the bed boundaries in surface and sub-surface.
- Folds, faults and unconformities: geometrical methods.
- Introduction to the stereographic projection.
- Cross-sections and geological history of ideal geologic maps.

Block 2 Collsacabra

Practical interpretation of the geology of the Collsacabra-Tavertet area using topographical map and satellite images. Introduction to digital/network resources and applications (e.g. Google Earth, the ICGC map viewer, the IGME map viewer).

Block 3 Vallcebre

Geologic fundamentals and interpretation using the aerial photography. Stereoscopic techniques. The practical case of the Vallcebre syncline.

Block 4 Geologic Maps

Analysis of real geologic maps. Cross-section construction and interpretation of geologic maps. The map difficulty will increase through the course.

- Colorado Canyon (USGS map)
- Amer Fault (ICGC map)
- Tragacete (IGME map)
- Aiguaviva (IGME map)

Field trip contents

Elaboration of a geological cartography and technical report of an aprox. 3 km² area in Mora d'Ebre-La Figuera (Tarragona). The contents included in this block are the following,

- Outline of main geological units using topographic maps, satellite images and aerial photographs.
- Observation and acquisition of field data to elaborate a geologic map.
- Elaboration of a technical report including the stratigraphic description of the main units, cross-sections and geologic history. Adequate use of the bibliography.

Methodology

Theory and practical contents

The course is organised in four practical blocks:

Block 1 Geometrical problems

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- Determination of the orientation of a plane using geometrical techniques.

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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			
Field work	35	1.4	8, 5, 2, 3, 1, 6, 7, 10
Practical Lab	48	1.92	8, 5, 4, 7, 11
Theory	2	0.08	8, 4
Type: Supervised			
Geometrical problems and interpretation of geological maps	55.5	2.22	5, 1, 4, 7, 11

Reading of specialised lectures, bibliography, etc	10	0.4	8, 1, 4, 11
Type: Autonomous			
Field work	32.5	1.3	8, 5, 2, 3, 1, 4, 6, 7, 11, 9, 10
Field work report and geological map	25	1	8, 5, 3, 4, 7, 11, 10
Interpretation and geological cartography using aerial photographs and orthophotomaps	30	1.2	8, 5, 1, 4, 7, 11

Assessment

In order to achieve the competencies of the course, it is important the continuous work and effort by the students. It is essential that the students become deeply involved in solving the proposed problems and interpretation of geological maps, since both constitute an important goal of the course. For this reason, the methodology of the course has been defined to promote an autonomous learning environment by the students.

A basic aspect of geological cartography is the understanding of geological bodies in three dimensions. It is therefore recommended that the student use both the digital resources available and the recommended bibliography in order to achieve this understanding. Special attention will be focused to the proper and accurate use of the language and the geological nomenclature by the students.

Normative to nonattendance to supervised activities

All supervised sessions are obligatory.

- Students will receive a mark of "fail" (i.e. 0) in the assessment of the "Geometrical Problems" block if there are more than two sessions with nonattendance. The same criteria will be applied to the assessment of the "Geological Maps" block.
- The nonattendance in a session of the "Collsacabra" or "Vallcebre" blocks imply a mark of "fail" (i.e. 0), in this part of the course.
- The nonattendance to any day of the field trip imply a mark of "fail" in the final grading of the course

Only students who have participate to lower than 35% of the assessment activities of the course could receive a "not assessable" grading. Otherwise, the students will receive a mark following the "assessment-grading"s norms.

Assessment - Grading

The final grading of the course will be done following the next distribution:

A1. Grading of the "Geometrical Problems" Block. The assessment of this part of the course will be done from the weighted sum between the exam (75 %) and the submitted problems during practical sessions (25 %).

A2. Grading of the "Geological Maps" Block. The assessment of this part of the course will be done from the weighted sum between the exam (75 %) and the submitted problems during practical sessions (25 %).

A3. Grading of the "Collsacabra" Block

A4. Grading of the "Vallcebre" Block

A5. The grading of the field work will consist in the following sections.

A5.1 Material elaborated and delivered in the field. The students during the field work will submit a diary copy of the working field map and the last day they will submit a copy of the final working field map, the sedimentary log and a cross-section of the studied area. In this section also will be considered the attitude of the students during the field work.

A5.2 Geological report and oral examination. The student will submit a printed copy of the field report before the indicated deadline. The oral examination will consist to answer to a series of questions related with the field work and report.

There are only reassessments to the activities if "Geometrical Problems" (AR.1), "Geological Maps" (AR.4) and the field report (AR.5.2). The reassessment of AR.1 and AR.4 will be done through an exam, with maximum reassessment of the 35% of the final mark of the course. The reassessment of AR.5.2 will be done through a new submission of the field report, with maximum reassessment of the 25% of the final mark of the course.

The students who failed these activities, it is mandatory to present to the reassessment activities. The nonattendance to a reassessment activity will imply to fail this part of the course (i.e. A1=0 o A4=0).

The final grading will be done after the reassessment activities. The calculation will be done following the next considerations,

1) Firstly, the average score from the lab blocks (i.e. Geometrical problems, Collsacabra, Vallcebre and Geological maps) will be calculated. This score will be calculated attending the relative weighting of the different blocks following the next equation,

$$Q1 = 0,30 \cdot A1 + 0,30 \cdot A2 + 0,15 \cdot A3 + 0,25 \cdot A4$$

2) If Q1 is equal or larger than 4, then the qualification will be calculated using the next equation,

$$QF = 0,175 \cdot A1 + 0,175 \cdot A2 + 0,10 \cdot A3 + 0,15 \cdot A4 + 0,20 \cdot A5.1 + 0,20 \cdot A5.2$$

3) In the case that Q1 is lower than 4, the qualification will be "fail" and the score will be calculated using the equation,

$$QF = 0,30 \cdot A1 + 0,30 \cdot A2 + 0,15 \cdot A3 + 0,25 \cdot A4.$$

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
A1. Geometrical problems	17,5 %	2	0.08	8, 5, 4
A2. Collsacabra	10%	0.5	0.02	5, 4, 7, 11
A3. Vallcebre	15%	0.5	0.02	5, 1, 7, 11
A4. Geological maps examination	17,5 %	2	0.08	5, 4, 11
A5.1 Firdl material elaborated and submitted during field trip	20%	1	0.04	8, 5, 2, 3, 1, 4, 6, 7, 11, 9, 10
A5.2 Field report and oral examination	20%	6	0.24	8, 5, 2, 3, 1, 4, 6, 7, 11, 9, 10
AR.1 Reassessment of "Geometrical problems"	17.5	0	0	5, 3, 11
AR.4 Reassessment of "Geological Maps" block	17.5	0	0	5, 3, 11

Bibliography

New References

Lisle, R.J., Brabham P. & Barnes J.W. 2011. *Basic Geological Mapping*. Wiley-Blackwell, 230 pp.

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Boulter, C. A. 1989. Four dimensional analysis of geological maps: techniques of interpretation. John Wiley and Sons, 296 pp.

Institut Geològic de Catalunya (Ed.) 2010. *Atles Geològic de Catalunya*. Barcelona, 462 pp.

Marshak, S. & Mitra, G. (Eds) 1988. *Basic methods of Structural Geology*. Prentice Hall, Englewood Hills. 446 pp.

Oms, O., Vicens, E. i Obrador, A. (2002) Introducción al mapa Geológico (1): Topografía y Fundamentos. Monografías de Enseñanza de las Ciencias de la Tierra. Serie Cuadernos Didácticos, número 2.

Pozo, M., González, J. I Giner, J. (2004) *Geología Práctica. Introducción al reconocimiento de Materiales y Análisis de Mapas*. Pearson-Prentice Hall, paginas?.

Ragan, D.M. 1980. *Geología Estructural: Introducción a las técnicas geométricas*. Omega. Barcelona. 207 pp.

Reynolds, S. et al., 2010. *Exploring Geology*. Mc Graw-Hill, 578 pp.

Weijermars, R. 1997. *Structural Geology and Map Interpretation*.. Alboran Science Publications. Amsterdam. 378 pp.

Strahler, A. N., 1981. *Geografía Física*. Ediciones Omega, Barcelona, 767 pp.

Software

To follow the course it is necessary to use Google Earth as specific computer program.