26416 - Geological Mapping

Información del Plan Docente

Academic Year	2017/18
Faculty / School	100 - Facultad de Ciencias
Degree	296 - Degree in Geology
ECTS	9.0
Year	3
Semester	First semester
Subject Type	Compulsory
Module	---

1.General information

1.1.Introduction

Brief presentation of the course

The aim of this module is to introduce the Geological Mapping as a technique for representing and analysing the Geology of a region because it reflects the attitude, evolution, nature and structure of the materials.

1.2.Recommendations to take this course

Geological Mapping represents a basic topic of the field Geology. This subject includes learning on basic geometry of geological bodies (sedimentary or igneous rocks) and geological structures, so it is recommended to know other subjects as Stratigraphy, Structural Geology, Petrology or Geomorphology. The geological mapping is a useful tool for analysing most aspects of Geology and it needs of the development of determined observation skills in the field and the representation of such observations on a map. Other needed skills are the elaboration of geological cross-sections or block-diagrams as additional tools for map interpretation. It is recommended: (i) to attend every theoretical and practical session and to take an active participation in them; (ii) to have passed a previous, basic course on Structural Geology and Stratigraphy; (iii) knowledge of basic Spanish and English.

It is strongly recommended to study this subject before any other whose contents require the use of geological maps.

1.3.Context and importance of this course in the degree

This course is part of a group of subjects of the *Degree in Geology* that constitute the basic training in Geology.

1.4.Activities and key dates

This module consists of lectures, field work, practical laboratories, tutorial exercises, case histories and coursework exercises.

Beginning of the course: beginning of the second semester according to the academic calendar established by the

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Faculty of Sciences and published on its website.

Timetable: according to the schedule established by the Faculty of Sciences and published on its website.

2.Learning goals

2.1.Learning goals

The student, in order to pass the course, will have to show her/his competence in the following skills:

1. From a geological map: a) identify the main type of stratigraphyc contacts and tectonic structures, b) make geological cross-section ans sketches reflecting the geometry of geological structures and their relationships and d) deduce the geological history for the region.

2. From field observations, identify each body rock and contact type (stratigraphic, tectonic, magmatic,...) and the tectonic structures and represent them on a topographyc map.

3. To use the photogeological analysis as a mapping technique.

4. To know and aply the fundamentals of geometrycal analysis for solving problems of geological mapping.

5. To use the compass for measuring the orientation of geological contacts and structures.

6. To make and interpret geological maps.

7. To develop capabilities for scientific work: to select and process critically bibliographic information in Spanish and English; to communicate efficiently scientific contents, both oral and writen (in Spanish and, at a basic level, in English); to work alone and within a group.

2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

The expected results of the course respond to the following general aims

1. To make accurate and precise geological maps.

2. To interpret geological maps.

3. To introduce and apply the photogeological mapping technique.

4. To introduce and apply the orthographic projection in geological mapping.

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5. To undestand in the field the basic techniques in geological mapping and to develop skills for data acquisition.

3.2.Competences

Acquisition of field data for geological mapping.

To use the more adequate laboratory techniques for geological mapping.

To interpret geological maps.

To do thematic maps and cross-sections.

To solve geological questions by using the ortographic projection.

4.Assessment (1st and 2nd call)

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

4.1.1. General design of evaluation activities

Practical field activities in Geology and, above all, in the subject of Geological Mapping are of special relevance since it is where the student acquires and develops a great part of his / her abilities of observation, recognition and presentation of the results of this work on a Map. In fact, field activities are part of 2 evaluation activities (Report of the field area and Report from an inland cartography) which represent, respectively, 50% and 5% of the note in the scale of Evaluation (see evaluation criteria).

There are two modalities of evaluation of the subject Geological Mapping. The first one related to its on-site development (**Continuous Assessment**) and another (under the Regulation of Learning Assessment Standards, agreed on December 22, 2010 by the Governing Council of the University of Zaragoza, Art. 9.1) for cases In which it is not attended in person, by means of the realization of a **Global Assessment Test** , which includes all the theoretical-practical activities contained in this subject.

4.1.2. Assessment activities

Modality A: Continuous assessement

In the normal development of the subject (for First and Second Summons), ie carried out in person by the student during the course, the evaluation activities will consist of a continuous evaluation of the subject of different learning activities. These include:

1) **Reports of cabinet practices** . Five practices will be selected from those carried out during the semester, from which

the student will make an individual report, whose results will be evaluated from 0 to 10 points. The final grade of this section will be the arithmetic average of the grades of the selected practices. Learning activities 2, 4 and 6 are evaluated.

2) **Field Zone Report** . From the field work (6 days) and photogeological of a field area, the students must carry out, in a fundamentally autonomous way, the cartography of the same and make a memory that includes: 1) a geological mapping, 2) geological sections (3) a complete description of the mapped lithologic units and (4) a geological interpretation of the region including its 4D evolution. The field work will be carried out in small groups but **the memory will be individual** . This final report should include a one-page English summary. It evaluates from 0 to 10. Learning outcomes of all learning activities are evaluated (1 to 6).

3) **Report of mine mapping** . From the field study (1 day) and the study (1/2 session), students must individually make a report of the requested mine mapping. It evaluates from 0 to 10. Learning outcomes of all activities (1 to 6) are evaluated.

4) **Writtten partial tests of continuous evaluation** . It will consist of three parts that can be evaluated in different tests during the course. **Part 1** : brief theoretical-practical issues on aspects of bounded planes, addressed in the course's practical program of the subject. **Part 2** : photogeological interpretation of a region and transfer of the information to the topographic map. **Part 3** : reading and interpretation of a geological map of the MAGNA series and realization of a geological section. The maximum joint duration of the tests will be 6 hours. Each part is evaluated from 0 to 10 sts. The final grade in this section will be the sum of the grades obtained in the different parts. This test evaluates learning outcomes 1, 2, 3, 4 and 6.

5) **Written final exercise** . For students who do not pass the partial written tests, there will be a final written test that will be done during the final examination period established by the Faculty of Sciences that is published on its website. This examination will consist of the same three parts described in the partial tests and the student must be presented, at least, to the parts not previously surpassed.

For evaluation tests Continues 1, 2 and 3, the day of delivery of the documents requested for the evaluation, will be indicated in advance throughout the course.
Those parts (evaluation activities 1, 2, 3 or 4) that are not passed with a score equal to or higher than 5 in the first call may be recovered in the second call.

Modality B. Global test of evaluation

Modality of evaluation for the students who did no attend the subject, or students who, still being it done, wish to take refuge in their right to a global evaluation (for First and Second Summons). In both calls, the following tests:

1) A **written test** similar to that of section 4 of the Continuous Evaluation Mode.

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2) A **practical test** that will include exercises in learning activities 2, 4 and 6.

3) An **additional test** , which will consist of two parts: a) a field exam (1 day) in which the student will carry out a mapping of an indicated area and b) a cabinet exam (one morning or afternoon) in which The student will complete the cartography, make a geological cut and make the proper descriptions and interpretations of the field area studied. This second test includes the evaluation of field practices.

4.1.3. Final Assessment Scale

Evaluation of modality A

1) Cabinet practices. . . . . 20 % (factor 0.2)

2) Report of a field zone . . . . . 50 % (factor 0.5)

3) Report of a mine mapping . . . . . 5 % (factor 0.05)

4) Partial/final written exercices . . . . . 25 % (factor 0.25)

In practice it means multiplying the grade obtained in each evaluation activity by the indicated factor and adding the results to obtain the total score of the continuous evaluation.

In order to pass the course by means of the **Continuous Assessment mode** , each one of activities 1, 2, 3 and 4 must be independently and with a grade of 5 (or higher). In addition, in the case of written tests 4), the score should be >= 5 in each of the partial tests. As indicated, in the case of Activity 1, the final grade of this section (which should be >= 5) will be the arithmetic average of the grades of the selected practices.

Evaluation of modality B

1) Written test . . . . . 20 % (factor 0.2)

2) Practical test. . . . . 20 % (factor 0.2)

3) Adittional test. . . . . 60 % (factor 0.6)

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In order to pass the subject through the **Global Assessment Test modality** , they must independently pass a score of >= 5 each of the 3 tests.

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

The programme of the course is not the target, but a framework for developing personal work of students. In this way, time devoted to theoretical lectures will be reduced to a minimum, in benefit of collective discussion on practical exercises and case studies. Laboratory sessions will be mainly devoted to analysis of the most common techniques for geological mapping construction and interpretation. Fieldwork will focus on the recognition of geological contacts and geological structures, collection of detailed observations and orientation measurements on them. The obtained data will be represented on the student's notebook by means of tectonic schemes and cross-sections and used for the geological mapping of the region. Tutorials will be considered another academic activity where the student will be free to: (i) ask any doubt related with the subject; (ii) receive orientation about information sources; (iii) ask for guidelines about personal work and report elaboration.

5.2.Learning tasks

Actividty 1 . Learning of conceptual bases of geological mapping.

Metodology: **Theoretycal Classes** (1 ECTS; 10 h)

Activity 2 . Practical exercises using orthographic projection in geological mapping.

Metodology: **Practical sessions** (1 ECTS; 10 h).

Activity 3 . Photogeological interpretation.

Metodology: **Practical sessions with photograph stereopairs** (1.3 ECTS; 13 h).

Activity 4 . Realization of geological maps and cross-sections.

Metodology: **Practical sessions** (1.5 ECTS; 15 h).

Activity 5 . Acquisition of geological data and mapping in field in different regions.
Metodology: **Fieldwork** (3 ECTS, 7 journeys).

Activity 6 . Interpretation of geological maps.

Metodology: **Practical sessions** (1.2 ECTS; 12 h).

Activities in English (1 ECTS)

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During the development of the subject it is proposed that the student knows and uses the proper terms of Cartography and Basic Geology not only in Spanish but also in English. With this objective, in addition to introducing the terminology in the various face-to-face activities, some of the activities mentioned above will be developed in English. Activities in English will include: 1) bibliography management in English, 2) introduction to the methodology used in photogeology and 3) reading of works in English, provided by teachers, for later application in the writing of the memory of the area Of field. Regarding the latter aspect, a commentary on one or more articles in English should be included in the background section of the report. In addition, the contents of an article in English should be used in the Discussion section of the field memory.

5.3.Syllabus

I. THEORETICAL CONTENTS

The theoretical contents, treated during the sessions and practices, of the subject include:

1. **Orthographic projection.** Fundamentals and their use to solve problems of cartography (intersection of planes, calculation of displacements of faults and separations, real displacement and components ...).
2. **Systems of representation of tectonic structures (review)** . Maps and geological sections; Blocks diagram. Thematic maps. Orientation of planes and lines; Direction and dip; Apparent dipping; Immersion and pitch.
3. **Elements of cartography (review)** . The rule of "VV". Mapping of horizontal stratified, folded and / or fractured series and complex cartography.
4. **The geological history** . Bases for interpreting the geological history of a region from the cartography.

II. PROGRAM OF CABINET PRACTICAL SESSIONS

Chronologically, the cabinet practice program includes:

1. **Practice 0** (one session). Review of diverse aspects of geological mapping (interpretation of geological maps and cross-sections).

2. **Orthographic projection 1** (one session). Determination of apparent thicknesses of units. Three-point problems.

3. **Orthographic projection 2** (one session). Three-point problems (continuation) and problems of fault components.

4. **Orthographic projection 3** (one session).Practice test type.

5. **Photogeology 1** (five sesiones). Photogeological study of the field zone (place to be determined).

6. **Map and cross-sections of the field zone** (four sessions).

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7. **Photogeology of a folded región** (two sessions): The Pico del Águila region.

8. **Geological map I** (one session): Stratigraphic discontinuities and folds.

9. **Geological map II** (one session): Stratigraphic discontinuities and faults

10. **Geological map III** (one session): Folds, faults and stratigraphic discontinuities

11. **Geological map IV** (one session): Complex geological maps.

12. **Mine mapping** (1/2 session).

III. PROGRAM OF FIELDWORK

Chronologically, the fieldwork program will be developed over 7 days (3 ECTS):

Journeys 1 to 6

Place : Field zone to be determined each course

Date : According to academic calendar published on the web of the Department of Earth Sciences (Zaragoza University).

Activities : Cartography and field data collection.

Journey 7

Place : Mine to be determined each course

Date : According to academic calendar published on the web of the Department of Earth Sciences (Zaragoza University).

Activities : Cartography and mine data collection.

5.4.Course planning and calendar

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- 10 h of theoretical classes (≈ 1 h/week).

- 50 h of practical sessions in laboratory (≈ 5 h/week).

- 7 journeys of fieldwork (3 ECTS):

The close relationship between theoretical and practical classes have conditioned that they have included within the same shedule, in two sessions of three hours by week according to the following groups:

Group 1: Tuesday (15-18 h) and Thursday (16-19 h).

Group 2: Wednesday (15-18 h) and Thursday (9-12 h).

5.5.Bibliography and recommended resources

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BB	Barnes, John W.. Basic geological mapping / John W. Barnes . - 3rd ed. reprint.
BB	Basic methods of structural geology. Part I, Elementary techniques / by Stephen Marshak, Gautam Mitra. Part II, Special topics. Englewood Cliffs, New Jersey : Prentice Hall, cop. 1988
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BB	Bennison, G. M.. An introduction to geological structures and maps / G. M. Bennison and K. A. Moseley . - 7th ed. London : Hodder Education, cop. 2003
BB	Blyth, F.G.H.. Geological maps and their interpretation. 2nd Cambridge University Press, 1976
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BB Fernández Martínez, Esperanza M.. Del papel a la montaña : iniciación a las prácticas de cartografía geológica / Esperanza M. Fernández Martínez, Antonio López Alcántara León : Universidad de León, 2004

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BB Gómez Ortiz, David. Introducción a la geología práctica / David Gómez Ortiz , Tomás Martín Crespo , Silvia Martín Velázquez Madrid : Editorial Universitaria Ramón Areces , D. L. 2004

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BB Lisle, Richard J.. Geological structures and maps : a practical guide / by Richard J. Lisle . - [1st ed.] Oxford [etc.] : Pergamon Press, 1988

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BB	Martínez-Álvarez, J. A.. Cartografía geológica / J. A. Martínez-Álvarez Madrid : Paraninfo, 1989
BB	Martínez-Álvarez, J. A.. Mapas geológicos: explicación e interpretación/ J. A. Martínez-Álvarez . - 3a ed. act. Madrid : Paraninfo, 1985
BB	Martínez-Torres, Luis Miguel. Planos acotados aplicados a geología : [problemas resueltos] / L.M. Martínez-Torres, R. Ramón-Lluch, L. Eguiluz Bilbao : Servicio Editorial de la Universidad del Pais Vasco, 1993
BB	Mattauer, Maurice. Las deformaciones de los materiales de la corteza terrestre / Maurice Mattauer ; [traducido por Mateo Gutiérrez Elorza y Jesús Aguado Sánchez] . - [2a ed.] Barcelona : Omega, D.L. 1989
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LISTADO DE URLs:

Guía tridimensional interactiva de prácticas - [http://ocw.innova.uned.es/cartografia/]

Stephen J. Reynolds: Arizona Geology - [http://reynolds.asu.edu/]