COURSE DATA

Data Subject	
Code	44301
Name	Geological cartography for palaeontologists
Cycle	Master's degree
ECTS Credits	3.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
2200 - M. U. en Paleontología Aplicada	Faculty of Biological Sciences	1	First term

Subject-matter

Degree	Subject-matter	Character
2200 - M. U. en Paleontología Aplicada	3 - Advanced scientific training	Optional

SUMMARY

Geological mapping is a basic tool of representation and interpretation in Geology and other Earth sciences.

Given the nature of Palaeontology as a science somewhere between Geology and Biology, the knowledge and application of geological mapping are essential in the paleontological work. Moreover, making geological maps often need for paleontological data, either for dating rocks or identify the mapped rock units and structures that affect them.

Geological maps are also essential to reconstruct the geologic history of the region represented, so that the paleontological data on them are crucial for both the dating of events occurring in the region and the palaeoenvironmental evolution of the area shown on the map.

Finally, they are very useful in conveying the paleontological knowledge, whether in publications, reports , presentations, ... since the palaeontological material is placed on its geological and geographical context.

The course is designed to provide basic training to students who have completed degrees in those subjects not included in this theme. Grade students as Geology and Geological Engineering already have training in it, even at higher levels to which it is taught in this course.

To begin with, we deal with the classification and identification of sedimentary rocks, and minerals that form them, since they are the the most likely lithologies a paleontologist is going to face in the field and will find associated with paleontological sites in the maps.

Next, in the specific field of geological mapping, it is about of learning to interpret a geological map through the knowledge of standard symbols used in it, and how to represent the topography, rocky bodies, deformation structures, ... by using the method of dimensioned drawings. We follow with the basic geometrical procedures that allows, from maps, the calculations of relevant geological data (direction and angle of dip of the geological structures, thickness and depths of rocky bodies, slopes,...)

The map interpretation requires the construction of geological cross-sections, whose elements are also included in the course, and the development of stratigraphic logs and the geological history, from the map data and cross-sections.

In turn, the subject deals with methods of construction of geological maps using field data, both lithological and paleontological, and with the help of the photogeology.

The approach is theoretical and practical, so it has special relevance the continued application of the theoretical foundations that are giving, so that practices are perfectly coordinated with the theory; the development of the lectures also includes case studies that help their comprehension as well as to develop the skills needed to

English
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PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

There are not prerequisites, since it is precisely a basic complement for those students who have not received degrees in which the subject is taught in depth. In its program the basis for its understanding and application are included.

On the other hand, students have to acquire a set of drawing and calculation materials for both practice sessions and lectures, as detailed below:

Required:
-Mechanical pencil 0.5 mm
-Eraser
-Rule or scaler
-Protractor
-Set squares
-Graph Paper (DinA4)

-Calc

OUTCOMES

2200 - M. U. en Paleontología Aplicada

- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Be able to access to information tools in other areas of knowledge and use them properly.
- To be able to assess the need to complete the scientific, historical, language, informatics, literature, ethics, social and human background in general, attending conferences, courses or doing complementary activities, self-assessing the contribution of these activities towards a comprehensive development.
- Be able to apply the research experience acquired to professional practice both in private companies and in public organisations.
- Be able to communicate and disseminate scientific ideas.
- Be able to apply the research experience acquired to begin the research phase of a doctoral programme in the field of biodiversity.
- Ser capaces de trabajar en equipo con eficiencia en su labor profesional o investigadora, adquiriendo la capacidad de participar en proyectos de investigación y colaboraciones científicas o tecnológicas
- Ser capaces de realizar una toma rápida y eficaz de decisiones en situaciones complejas de su labor profesional o investigadora, mediante el desarrollo de nuevas e innovadoras metodologías de trabajo adaptadas al ámbito científico/investigador, tecnológico o profesional en el que se desarrolle su actividad.
- Aplicar el razonamiento crítico y la argumentación desde criterios racionales.
- Aplicar la Ciencia desde la óptica social y económica, potenciando la transferencia del conocimiento a la Sociedad.
- Capacidad para preparar, redactar y exponer en público informes y proyectos de forma clara y coherente, defenderlos con rigor y tolerancia y responder satisfactoriamente a las críticas que pudieren derivarse de su exposición.
- Proyectar la inquietud intelectual y fomentar la responsabilidad del propio aprendizaje.
- Asumir el compromiso ético y la sensibilidad hacia los problemas medioambientales, hacia el patrimonio natural y cultural.

- Conoce la naturaleza del registro estratigráfico, sus discontinuidades, los ciclos y eventos, los diferentes tipos de cuencas sedimentarias, los factores que controlan su relleno, las geometrías tridimensionales resultantes y las correlaciones estratigráficas.
- Recoger, representar y analizar datos para la interpretación y realización de cartografías geológicas y/o otros modos de representación (columnas estratigráficas, cortes geológicos, etc.) con vistas a su implementación en informes, publicaciones científicas u otros resultados.
- Elaborar de una forma clara y concisa, todo tipo de memorias relacionadas con la temática paleontológica a nivel oficial o profesional (informes, subvenciones, memorias de impactos patrimonial, proyectos de investigación, etc.)

LEARNING OUTCOMES

-Identification in laboratory and in the field of the most common types of rocks, with particular attention to sedimentary rocks.
-Interpretation of an advanced geological map, making a geological cross-section and recognizing its geological history.
-Recognize on the geological map of the area the different structures observable in the field, identifying its spatial and temporal relationships.
-Development of skills in carrying out the techniques of making the geological maps and its possible applications to Palaeontology.
-Learn to make simple geometric calculations in a geological map in order to make the interpretation of relevant geological parameters in the palaeontological and geological research.
-Find the place where you are in the field by using a topographical map and GPS.
-Realize that Paleontology is important in the development of geological mapping.
-Learn the use of geological maps in the representation of research results and scientific communication.

DESCRIPTION OF CONTENTS

1. Geological Mapping basic knowledges

Topic 1: Geological Mapping basic concepts for the interpretation of geological maps. Sedimentary rocks: detrital and non-detrital. Stratification. The superposition rocks principle and others related concepts. Sedimentary polarity critera: normal and reversed. Stratigraphical units classification: lithological and mappeable units (1 hour).
Topic 2: Cartographic bases applied to geological maps. Topographic map. Scales. Orientation. Coordinates and use of GPS. Dimensioned planes to represent relief: contour and equidistance curves. Main morphologies types. Topographic profiles. Calculation of topographic slopes (1 hour)

2. Geological Mapping basic concepts for the interpretation of geological maps.

Topic 3: Representation of the topographical plans. Main elements: Horizontal plan and maximun dip line, direction and angle of true dip. True and apparent dip. Use of the compass and electronic tools (1 hour)
Topic 4: Intersection of planes with the topography. The rule of Vs.
Intersection of horizontal, verticals and inclined planes. Exception of the rule of Vs. Determination of the true dip of a plan. Intersection of planes. Lineation. The contourned lines method. (1 hour)

3. Interpretation of the geological maps

Topic 5. Simple Geological structures: Horizontal and reclined sedimentary series. Real and apparent thickness. Stratigraphical discontinuites: concept of continuity/discontinuity, and conformity/non conformity and their Identification. Stratigraphical column and geological history (1 hour).
Topic 6. Cartography of folded areas: concept and fold composition. Efforts types. Antiform and synform. Normal, reclined and overthhrow folds. Vergence. Normal and inverted limb. Cartographic identification of the folds. Simbology.
Topic 7. Cartography of faulted areas: concept and fault composition. Efforts types. Normal, inverted and strike faults. Thrusts. Cartographic identification of the faults. Fault system. Simbology. Folds and faults associations. Concept of socket and cover (1 hour)
Topic 8. Intrusive rocks and structures and their cartographic representation. Batholiths, dikes and sills, volcans. Diapirs and its cartographic representation (0,5 hour)
Topic 9. Specific applications of the Paleontology in the geologic maps: Datation of the lithological units. Sedimentary polarity markers. Recognition of discontinuities and deformation structures (0,5 hour)

4. Labs 1

Lab 1. Identification of sedimentary rocks and minerals composition (2 hours)
Lab 2. Topographic maps. Scales. Coordinates. Topographic profiles (2 hours)
Lab 3. Dimensioned planes. Beds tracing and triangulation method. Dip of a plane (2 hours)
Lab 4. Maps with horizontal and reclined strata. Thickness calculation (2 hours)
Lab 5. Maps with simple discordances (2 hours)
Lab 6. Maps with folded structures (2 hours)
Lab 7. Maps with faulted structures (2 hours)
Lab 8. Maps with complex structures, folded and faulted. Thrusts (2 hours)
Lab 9. Intrusive and extrusive structures. Volcanism and Diapirism (2 hours)
Lab 10. Interpretation on the real geological map and Its paleontological application (2 hours)
Lab 11. Introduction of the fotogeology (2 hours)

WORKLOAD

ACTIVITY	Hours	% To be attended
Laboratory practices	22,00	100
Theory classes	8,00	100
TOTAL	30,00	

TEACHING METHODOLOGY

The course has been planned in such a way that it has a purely practical character, which can already be seen in the ratio between theory and practical hours (8/22). In this way, students can extensively apply the theoretical knowledge to problems and practical cases, so that they quickly acquire and consolidate the competences that are worked on in the course. The activities proposed are, in summary: 1) Theoretical classes with application to problems and case studies, 2) practical classes in the laboratory, where they work in depth on problems and simulated and real maps, and 3) individual work that students develop outside the classroom, with problems and case studies posed both in theory and in practice, and that make them face alone and without outside help, the problems posed in the course.

Theoretical classes. It is based on the master class, where the students will previously have a script provided by the teacher. The professor will explain the essential parts of the theoretical content of the corresponding subject, emphasizing the most complex aspects and practical applications. During the same class, students will participate by carrying out small exercises (simple case studies), which the teacher will propose after the corresponding explanation, and which can be carried out in collaboration with their classmates.

2. Practical classes. The first one is focused on the study and recognition by the students of the main sedimentary rocks and the minerals that form them. The following ones are conceived to apply in an extensive way what has been seen in the theoretical classes, with map problems, first topographic and then geological with structures in increasing difficulty, from simple simulated cases to real maps. These practices are linked to concepts taught in the theoretical class immediately preceding. A last practice is intended to show the application of photogeology techniques to geological maps as well as to emphasize the contributions of Paleontology to the elaboration of geological maps. If it is considered appropriate, some practices will be carried out through a field trip to have other point of view from the basic concepts acquired.

Independent work. The problems, case studies and maps that are raised in the theory classroom and in the practices, then must be continued as autonomous work not presential, by means of the approach of exercises to be carried out by the students outside the classroom. These exercises will be delivered in the following class or practice for evaluation, and will be part of the final grade. The application of the learned cartographic techniques to the realization of a small geological map of a field area of those visited with the subject Fieldwork in Paleontology will also be proposed, which may count as an extra score.

EVALUATION

The evaluation of the theoretical and practical aspects of the subject will be carried out by means of an exam, which will eliminate the subject as long as the passing grade is reached or exceeded. The exercise will consist of three sections: a) examination of theoretical concepts (25%) b) examination of problems (35%) c) interpretation of a geological map (40%). For the sections b and c the student will be able to rely on his notes, exercises, maps made in practice, ... Each section (a, b and c) must be passed separately (grade of at least 5 out of 10 in each one); a failure in a section means not having passed the exam, except in the case of compensation: if one of the sections has a grade between 4.0 and 4.9 it can be compensated if the calculation of the final grade of the whole exercise is at least a 5. If there are two sections with a grade between 4 and 4.9, there is no possible compensation and the exam will not be considered passed, having to repeat the whole exam in the next exam session. This exam represents 50% of the final grade of the subject.

Class problems: At the end of each theory class, students will be given one or more problems related to the cases seen in the class, so that they can solve them independently and hand them in at the beginning of the next theory session. These exercises will be evaluated and will count for 15% of the final grade.

Laboratory: The laboratory-cabinet practices, apart from their participation in the exam mentioned above, will be evaluated continuously, in such a way that the exercises performed during each practice must be reviewed by the professor at the beginning of the following practice, and evaluated. In some cases, at the end of the practical, the professor will give the student a case study to solve and deliver at the beginning of the next practical. These practical cases, both those carried out in the session and those proposed for personal work, represent 25% of the final grade of the subject.

In the continuous evaluation the attendance to the theoretical and practical classes will be taken into account, as well as the participative attitude of the students. The evaluation represents 10% of the final grade.

The weight (percentage of the final grade), maximum value of the evaluated portion and minimum grade that would eliminate subject of the aspects considered in the evaluation of the subject (theory, practices and individual work) are reflected in the following table:

Portion of the subject evaluated	Number of exercises or reports	Percentage in the final grade	Maximum value in the final grade	Minimum value to pass the portion
Theory and practical exercises	1	50	5 points	5,0 points
Laboratory	12	25	2,5 points	5,0 points

Class problems	8	15	1,5 points	5,0 points
Continuous evaluation	-	10	1 point	-

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