60441 - Integrated basin analysis

Información del Plan Docente

Academic Year	2017/18
Faculty / School	100 - Facultad de Ciencias
Degree	541 - Master's in Geology: Techniques and Applications
ECTS	5.0
Year	1
Semester	Second semester
Subject Type	Optional
Module	---

1.General information

1.1.Introduction

Brief presentation of the course

The aim of this module is to provide essential background to acquire advanced training in basin analysis integrating different methods and techniques. Most training is oriented for applying field and laboratory techniques for studying the interrelations between the stratigraphic-sedimentological features of sediments and the structural geology and tectonic context of sedimentary basins where the sedimentation took place. Other research techniques and studies, such as sedimentary and igneous petrology, mineralogy, palaeontology, palaeogeography and hydrogeology, among others, are also outlined in order to achieve an integrated analysis of both extensional and compressional sedimentary basins.

1.2.Recommendations to take this course

This course, which is focused to acquire advanced training in basin analysis integrating different methods and techniques, is intended for students with a general background in Geology, particularly in Stratigraphy, Sedimentary Processes and Environments, Structural Geology, Tectonics, Geophysics and Sedimentary and Igneous Petrology.

For a better advantage of the course the students are encouraged to continuous attend the theoretical and practical sessions, which are strongly interconnected.

1.3.Context and importance of this course in the degree

This course is part of a group of subjects of the *Master in Geology: Techniques and Applications* that constitute the necessary training for those students who want to understand the formation and evolution of sedimentary basins and to develop skills for their study. Due to this subject enables the better understanding of sedimentary basins, it is essential and complementary to other applied subjects of the Master degree as, for example, Subsurface Geology or Geological Storages.

1.4.Activities and key dates

Beginning of the course: beginning of the second semester according to the academic calendar established by the Faculty of Sciences and published on its website.

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

Students will have to give the solved questionnaries and practical exercises in the date that indicates each professor.

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:

Understand the main stratigraphical and tectonic features of extensional and compressional sedimentary basins.

Knowledge and apply the distinct techniques to characterize the sedimentary infill and the palaeonvironmental reconstruction and their relationships with contemporary tectonic structures.

Knowledge the effects of the tectonic activity on the sedimentary infill of a basin and the sedimentary models developed in different tectonic contexts.

Knowledge the main tectonic models generating sedimentary basins depending on the geodynamic context.

Ability to handle the basic programs of palaeomagnetic data analysis used for regional tectonic studies, and the basic techniques for magnetic fabric and palaeomagnetic data interpretation and their application in tectonics and magnetostratigraphy.

Knowledge and apply techniques in analogue modelling for studying tectonic processes and to interpret the modelling results.

Knowledge the main physical-chemical techniques applied for reconstructing the evolution of sedimentary basins.

Knowledge the hydrogeological models operating in great sedimentary basins.

Understand the relative role of the main geological processes controlling the formation and evolution of the sedimentary basins.

2.2.Importance of learning goals

The integrated analysis of sedimentary basins is an important research field in Geology from the scientific and applied plain. The combined use of methodologies coming from distinct branch of the Geology for the study of sedimentary basins is relatively recent and is still in continuous development. From an applied point of view, the integrated analysis allows the reconstruction of the 3D stratigraphic and structural architecture of sedimentary basins, which is of special relevance for the characterization of sedimentary units as reservoirs or geological storages, and consequently for the evaluation of possible geological resources (e.g., oil, gas, water, mineral...). Accordingly, students that course and acquire the competences of this subject will be more able to develop scientific research on sedimentary basins and they can opt to continue their work in applied research in branches so important as the Petroleum geology or the Geological storage of CO_2 storage. In addition, this course foments the analysis and discussion of the results as a way to propose reasoned interpretations, which is desirable for both scientific and applied purposes.

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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 provide advanced knowledge about (a) the main stratigraphic and tectonic features of extensional and compressional sedimentary basins in different geodynamic contexts, (b) the different tectonic models generating sedimentary basins in both extensional and compressional tectonics, (c) the magmatism related to extensional/transtensional or compressional/trasnpressional context where basins develop, (d) the physical and chemical techniques of particular minerals used for reconstructing the evolution of sedimentary basins, and (e) the hydrogeological models of great sedimentary basins.
2. To introduce and apply the basic techniques of (a) data acquisition in order to characterize the sedimentary record and its palaeoenvironmental evolution and to reconstruct the geometry of contemporary tectonics structures, evaluating their role on geometry and distribution of sedimentary facies, (b) analysis of palaeomagnetic data for regional tectonic studies, and (c) analogue modelling for the study of formation and inversion of sedimentary basins.

3.2.Competences

After completing the course, the student will be competent in the following skills:

1. The integration of the main factors (tectonic, structural, stratigraphic, sedimentary, geophysical, palaeontological, hydrogeological, diagenetic, metamorphic and igneous) controlling formation and development of sedimentary basins.
2. The acquisition of data in the field surveys, their analysis and their interpretation.
3. The planning, organization, realization and exposition of the research on experimental modelling of tectonic processes, particularly for formation and evolution of sedimentary basins.
4. The integration of several types of evidence to formulate and to prove hypothesis on the formation and evolution of basins.
5. The interpretation of magnetic fabric and palaeomagnetic data and their application to studies on regional tectonics and structural geology.

4.Assessment (1st and 2nd call)

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

I. Assessment tasks

The student will prove that he/she has achieved the expected learning results by means of the following assessment tasks:

(a) Continuous assessment

To track the improvement and knowledge of the students, the assessment will be carried out during the learning process based on:

a.1) Evaluation of theoretical-practical questionnaires for writing answers. Each questionnaire will be evaluated from 0 to 10, but they could have different relative value. The final punctuation will be obtained from the weighted mean (after the relative value of each one) of the obtained evaluations.

a.2) Evaluation of a personal and individual practical work in which the results of the practical activities carried out during the course on a sedimentary basin (fieldwork, photogeological analysis, analysis and interpretation of data in laboratory/computer) will be presented and discussed. This report must have a final section with the interpretation and discussion of the main results and the relevant conclusions of the investigated sedimentary basin. This activity will be evaluated from 0 to 10.

(b) Global evaluation

Students that did no follow the course, and those that following it wish therefore it, could be evaluated with a global test of evaluation, which will consists of a written theoretical-practical exam of the assembly of the course contents (evaluated from 0 to 10).

II. Assessment criteria

(a) Continuous assessment

The student must demonstrate that has achieved the intended background through attendance, individual responses to questionnaires and individual resolution of problems presented in practices. The final mark includes: i) Response to theoretical-practical questionnaires (70%) and ii) Report of practical sessions (30%).

(b) Overall assessment

Written theoretical-practical exam (100%).

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. The 5 ECTS of this course correspond to 50 hours of classroom activities, which will be arranged in 18 hours of lectures, 18 hours of laboratory sessions and 16 hours of fieldwork (two trips).

The students will have class-notes given by the professor as the basis of their learning, but they must extend the information given in class using sources such as technical books and scientific journals.

In most of the practice sessions, the work is developed in a specific extensional basin, so that the learning process is based on a practical case.

The tutorials will be considered another academic activity where the student will be free to ask doubts related with the course.

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5.2.Learning tasks

The course includes the following learning tasks:

- Activity I. Lectures. They have the purpose of providing advanced knowledge about the main topics of the course.
- Activity II. Practice sessions. They include the solving of problems and cases, including some laboratory experiments (modelling) and practical work with the computer.
- Activity III. Field work (two trips). They have the purpose of applying the techniques of data acquisition and observations of sedimentary and structural features of sedimentary basins.
- Activity IV. Tutorials. Answering doubts generated during the course by the corresponding lectures.

5.3.Syllabus

The course will address the following topics:

(a) Lectures

Section I. Introduction

Topic 1. Extensional, compressional, transtensional and transpressional basins and their relationship with Plate Tectonics.

Topic 2. Subsidence and isostasy in sedimentary basin formation.

Section II. Stratigraphic and structural integrated analysis of extensional basins

Topic 3. Classifications and geometrical features of the sedimentary infill.

Topic 4. Sedimentary models in extensional basins.

Topic 5. Initiation and evolution of rifts.

Topic 6. Extensional tectonics and cross-section restoration and validation in extensional regimes.

Topic 7. The magmatism in extensional/transtensional basins

Topic 8. Experimental tectonics. Analogue models in basin formation.

Section III. Stratigraphic and structural integrated analysis of compressional basins

Topic 9. Tectonics in compressional basins. Inversion Tectonics.

Topic 10. Evolution of the sedimentary infill in compressional settings.

Topic 11. Sedimentary models in compressional basins.

Topic 12. The magmatism in compressional/transpressional basins.

Section **IV. Other studies and methodologies**

Topic 13. Physical and chemical techniques for basin evolution analysis.

Topic 14. The palaeoenvironmental reconstruction for basin analysis.

Topic 15. Hydrogeological models in sedimentary basins.

Topic 16. Magnetostratigraphy and magnetotectonics: application of palaeomagnetism and magnetic fabrics to tectonic studies of sedimentary basins.

(b) Practice sessions

1) Laboratory (18 h)

Session 1 (4h): Photogeological analysis and stratigraphical and stratigraphical-structural correlation.

Session 2 (2h): Reconstructing the geometry of normal faults in deep.

Session 3 (2h): Restoration of cross-sections in extensional regions.

Session 4 (2h): Photogeological analysis of geometrical features of the sedimentary infill in compressional basins.

Session 5 (2h): Construction of subsidence curves and geohistory.

Session 6 (4h): Analogue modelling of extensional basins.

Session 7 (2h): Analysis of palaeomagnetic data and magnetic fabrics for regional tectonic studies.

2) Field work (2 trips)

Day 1: Field survey in the Cretaceous Galve extensional basin.

Day 2: Field survey in the Palaeogene Aliaga compressional basin.

5.4.Course planning and calendar

The calendar of lectures and practice sessions is published by the "Facultad de Ciencias" in its website.

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The dates of field trips are correspond to the calendar published on the website of the "Departamento de Ciencias de la Tierra".

The dates for the submission of questionnaires and the practical report will depend on the corresponding professor.

5.5.Bibliography and recommended resources

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Analogue Modelling

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COMPLEMENTARY Bibliography (BC)

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