60441 - Integrated basin analysis

Información del Plan Docente

Academic Year	2016/17
Academic center	100 - Facultad de Ciencias
Degree	541 - Master's in Geology: Techniques and Applications
ECTS	5.0
Course	1
Period	Second semester
Subject Type	Optional
Module	---

1.Basic info

1.1.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.

1.2.Activities and key dates for the course

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.

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.Initiation

2.1.Learning outcomes that define the subject

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.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.

3.Context and competences

3.1.Goals

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.Context and meaning of the subject 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.

3.3.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.

3.4.Importance of learning outcomes

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.

4.Evaluation

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.Activities and resources

5.1.General methodological presentation

The learning process that has been designed for this course is based on the following activities:

The 5 ECTS of this subject correspond to 50 hours of classroom education, which will be arranged in 18 hours of theoretical courses, 18 hours of laboratory sessions and 16 hours of fieldwork (two journeys).

The students will have class-notes given by the professor as the basis for their learning, but they must extend the information given in class using sources such as technical books and scientific journals. In most of the practical sessions, the works are developed on a specific extensional basin, so that the learning processes 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 subject.

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5.2.Learning activities

The programme offered to the students to help them achieve the learning results includes the following activities:

Activity I. Theoretical classes. They have the purpose of providing advanced knowledge about the main topics of the course.

Activity II. Practical sessions. They include the resolution of problems and cases, including some laboratory experiments (modelling) and practices with computer.

Activity III. Field work (two journeys). They have the purpose of applying the techniques of data acquisition and observations of sedimentary and structural features of sedimentary basins.

Activity IV. Tutorial sessions. Resolution of doubts generated during the course by the corresponding lectures.

5.3.Program

(a) Theory program

Part I. Introduction

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

2. Subsidence and isostasy in sedimentary basin formation.

Part II. Stratigraphic and structural integrated analysis of extensional basins

3. Classifications and geometrical features of the sedimentary infill.

4. Sedimentary models in extensional basins.

5. Initiation and evolution of rifts.

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

7. The magmatism in extensional/transtensional basins

8. Experimental tectonics. Analogue models in basin formation.

Part III. Stratigraphic and structural integrated analysis of compressional basins

9. Tectonics in compressional basins. Inversion Tectonics.

10. Evolution of the sedimentary infill in compressional settings.

11. Sedimentary models in compressional basins.

12. The magmatism in compressional/transpressional basins.

Part IV. Other studies and methodologies

13. Physical and chemical techniques for basin evolution analysis.

14. The palaeoenvironmental reconstruction for basin analysis.

15. Hydrogeological models in sedimentary basins.

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

(b) Practical sessions

b.1) Laboratory (18 h)

Session 1 (2 h): Stratigraphical correlation of sedimentary successions.

Session 2 (2 h): Photogeological analysis. Stratigraphical correlation of sedimentary successions taking into account structural evidence coming from photogeological analysis and field survey.

Session 3 (2h): Construction of subsidence curves and geohistory.

Session 4 (2h): Reconstructing the geometry of normal faults in deep.

Session 5 (2h): Restoration of cross-sections in extensional regions.

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

Session 7 (2h): Photogeological analysis of geometrical features of the sedimentary infill in compressional basins.

Session 8 (2h): Analysis of palaeomagnetic data and magnetic fabrics for regional tectonic studies.

b.2) Field studies (2 journeys)

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

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

5.4.Planning and scheduling

Calendar of actual sessions and presentation of works

The calendar of theoretical and practical sessions as those published by the Facultad de Ciencias in its Web page.

The dates of field journeys according to the calendar published in the Web of the Departamento de Ciencias de la Tierra.

The date for the presentation of questionnaires and practical report will be according to the corresponding professor.

5.5.Bibliography and recomended resources

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