Basin Analysis

Code: 101065
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500254 Geology	OT	3
2500254 Geology	OT	4

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

It is a subject with a marked integrating character and synthesis of all the disciplines involved in sedimentary geology, emphasizing the stratigraphic interpretation of the subsurface. It is aimed at understanding the formation mechanisms of different types of sedimentary basins, as well as the characterization of their infill. It is therefore highly applicable to projects with economic objectives, mainly resource exploration (energy or water), as well as mitigation of the effects of climate change (identification of possible CO_2 storage in old reservoirs or saline aquifers).

It is assumed that students have acquired the basic knowledge of various branches of fundamental sedimentary geology in previous courses, and mainly stratigraphy, sedimentology and tectonics.

Objectives and Contextualisation

This course aims for students to gain knowledge of the dynamics of sedimentary basin formation and their infill, and to know how to organize their deposits from a sequential stratigraphic point of view. During the course, practical exercises will be carried out to value the integration of different methods of study of surface and subsurface geology. It is therefore a subject in which students are faced with techniques for obtaining data of various types and their geological interpretation. These data and interpretations will be aimed at understanding their application and potential to achieve economic, protection/conservation, or climate change mitigation objectives.

Competences

Geology

- Describe stratigraphic successions and their temporal dimension and use correlation and interpretation techniques.
- Draw up and interpret geological maps and other means of depicting geological information (columns, correlation frames, geological cross-sections, etc.)
- Learn and apply the knowledge acquired, and use it to solve problems.
- Obtain information from texts written in other languages.
- Plan the exploration and sustainable development of geological resources.
- Process, interpret and present field data using qualitative and quantitative techniques, and suitable computer programmes.
- Recognise, depict and reconstruct tectonic structures and the processes that generate them and relate types of rocks and structures to geodynamic environments.
- Suitably transmit information, verbally, graphically and in writing, using modern information and communication technologies.
- Synthesise and analyse information critically.
- Work in teams, developing the social skills needed for this.
- Work independently.

Learning Outcomes

1. Draw up partial evolution models of the sedimentary infilling of basins and its three-dimensional stratigraphic architecture.
2. Draw up stratigraphic columns and correlation frames.
3. Extrapolate the depth range of the stratigraphic units from data on surface sediments.
4. Learn and apply the knowledge acquired, and use it to solve problems.
5. Make stratigraphic columns and correlation frames and geological maps based on lithostratigraphic and chronostratigraphic units.
6. Obtain information from texts written in other languages.
7. Process stratigraphic and sedimentological data from the field in order to produce new synthesis data and documents.
8. Recognise, locate stratigraphically and evaluate units of economic value in the sedimentary succession of the basin.
9. Suitably transmit information, verbally, graphically and in writing, using modern information and communication technologies.
10. Synthesise and analyse information critically.
11. Work in teams, developing the social skills needed for this.
12. Work independently.

Content

Theory program

1. Introduction

2. Type of sedimentary basins:

    2.1. Extensional basins

    2.2. Compressional basins

        2.2.1. The South Pyrenean Foreland Basin

    2.3. Strike-slip basins

2.4. Basins associated with mobile substrates (salt and clay)

3. Stratigraphy of sedimentary basins:

3.1. Sequence stratigraphy: processes and controls

3.2. Seismic stratigraphy

3.3. Sequence stratigraphy of carbonate systems

3.4. Sequence stratigraphy of clastic systems

3.5. Clinoforms and trajectory analysis

4. Sedimentary routing and source-to-sink systems

5. Subsidence and thermal history of sedimentary basins

6. Application of basin analysis in the exploration, production and storage of energy and water resources

Program of practical exercises

1. Introduction to seismic reflection

2. Seismic extensional basin

3. Modern analogue extensional basin (Death Valley)

4. Seismic compressive basin

5. Modern analogue compressive basin (Zagros)

6. Seismic basin of mobile substrate

7. Wheeler diagram (chronostratigraphic)

8. Seismic stratigraphy

9. Sequence stratigraphy of clastic systems

10. Sequence stratigraphy of carbonate systems

11. Clinoform trajectory analysis

Presentations autonomous work on (1) sequence stratigraphy of a depositional environment or (2) example of sedimentary basin

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theoretical classes and practical exercises	56	2.24	1, 2, 3, 4, 5, 6, 7,

			8, 10, 12
Type: Supervised			
Original synthesis work on a type of basin and mentoring	16	0.64	1, 2, 4, 6, 7, 8, 9, 10, 11, 12
Type: Autonomous			
Study of the theory, completion of practical exercises and report on sequence stratigraphy or basin example	74	2.96	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

1. Managed activities

Theory sessions

This course consists of a theoretical part, with interactive classes in which the proposed syllabus will be explained and discussed, and guidelines will be given so that students can complete learning independently. The students will have the theory agenda in the form of presentations (in .pdf) and a bibliography recommended by the teaching staff on the Virtual Campus.

Laboratory practices and seminars

They will basically consist of carrying out exercises related to theory classes, and mostly focused on practical work on seismic reflection or satellite images. The exercises will be assisted by the teaching staff, who will solve problems of a general nature that will be discussed among all, as well as specific problems. The basic material is from real cases and the exercises must be delivered at the end of the practice or through the Virtual Campus at the end of the week where each exercise is worked on.

2. Supervised activities

Original work of synthesis on (1) sequence stratigraphy of a type of depositional environment or (2) an example of sedimentary basin

2a) Elaboration in groups of two students of an original work of synthesis on (1) sequence stratigraphy of a type of depositional environment or (2) a real example of a sedimentary basin. There will be a series of topics proposed by the teaching staff and they will be decided by draw.

Each work must deliver a broad summary, with the key figures (maximum 10 pages, including figures), which must be delivered in a .pdf file, in the space provided on the Virtual Campus, as well as the slides of the oral presentation that each group must perform during a time not exceeding 15'. Summaries and presentations should be studied by students as they can lead to exam questions.

2b) Group and individual tutorials
They are aimed at supporting the previous training activities and will be carried out in theory or practice hours, with prior announcement by the teacher and acceptance of the date by the students. Additionally, individualized tutoring has been provided in the teacher's office according to the schedule and order that will be indicated on the first day of class.

3. Autonomous activities

This section includes the study, the preparation of the papers and the study of the bibliography of recommended articles.

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.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Individual written tests	70	4	0.16	9, 10
Original synthesis work on sequence stratigraphy of a depositional environment or an example of sedimentary basin and mentoring	15	0	0	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Practical exercises dossier	15	0	0	1, 2, 3, 4, 5, 8, 9, 10

The assessment will be carried out on a continuous basis, and will be based on a minimum of 2 written partial tests, which constitute 70% of the final grade.

The original synthesis work on a concrete basin type will be also evaluated (accounting 15% of the final mark); the dossier with the practical exercises will also be evaluated and should contain the overall exercises (accounting 15% of the final mark). All deliveries must be made in the corresponding available space in the Moodle and strictly following instructions (index where appropriate, maximum number of Mb of the document, appointment of the documents, etc.).

In the partial written tests, the data will be determined by the teacher in agreement with the students. The questions may include practical aspects although what is mainly evaluated is the achievement of the theoretical aspects, and in the cases of include practical questions, the degree for solution of problems.

In the work on a specific type of basin, the scientific content, the ordered workflow, the writing and presentation will be evalued, as well as the correct treatment of stratigraphic and sedimentological data from bibliographic sources to produce new synthesis data and documents. A summary of the work, of a maximum of 5 pages including figures, will be deposited in the corresponding Moodle's space for delivery, as well as the ppt of the oral presentation that each student will have to do according to a maximum time no higher than 10 '. This activity assigns a value of 15% of the final mark.

The dossier of practical exercises will also be evaluated with all the finished practices, ordered chronologically, and this dossier must clearly reflect personal work. The verification of a copy of an exercise implies to fail the subject. This activity assigns you a value of 15% of the final mark.

Its is necessary to remark that the subject contemplates a degree of obligatory attendance to both theory and practical exercises classes.

The directed activities mean a substantial part of the learning activities of the subject. In order for a student to be evaluated by continuous assessment, he must attend [1] at least 70% of the theoretical sessions, and each day of presentations of works (both of the same student and of the different groups of students) and [2] 80% of the practical sessions with delivery of the dossier within the fixed time period and before deadline (day and hour determined by agreement between the teacher and the students).

Recovery tests
Students not passing the subject through continuous assessment may have a final oportunity. The subject of examination in the final exam is the full content of the course. In case of not having submitted the final dossier of the practical exercises and/or the work on a type of basin, the student who wants a recovery exam will have to deliver these works at the time of the final test for recovery. For the final note, the same percentages are

maintained than in the case of continuous evaluation (70% for the written test, 15% for work on a determined basin and 15% corresponding to the practice dossier). The note of this last test fully replaces the note previously obtained by continuous evaluation.

Bibliography

- Allen, P. A., & Allen, J. R. (2013). *Basin analysis: Principles and application to petroleum play assessment*. John Wiley & Sons.

- Catuneanu, O. (2022). *Principles of sequence stratigraphy*. Newnes.

- Coe, A. L. (Ed.). (2003). *The sedimentary record of sea-level change*. Cambridge University Press.

- Emery, D., & Myers, K. (2009). *Sequence stratigraphy*. John Wiley & Sons.

- Miall, A. D. (2013). *Principles of sedimentary basin analysis*. Springer Science & Business Media.

- Schlager, W. (2005). *Carbonate sedimentology and sequence stratigraphy* (No. 8). SEPM Soc for Sed Geology.

Software

- Google Earth

- MS Word

- MS PowerPoint

Language list

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	1	Catalan	second semester	morning-mixed
(TE) Theory	1	Catalan	second semester	morning-mixed