



IDENTIFYING DATA

Sedimentology

Subject	Sedimentology			
Code	V10G061V01205			
Study programme	(*)Grao en Ciencias do Mar			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish Galician English			
Department				
Coordinator	Rey García, Daniel Marino , Gianluca			
Lecturers	Alejo Flores, Irene García Gil, María Soledad López Pérez, Ángel Enrique Marino , Gianluca Nombela Castaño, Miguel Angel Rey García, Daniel Santos López, Artai Antón			
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General description Sedimentology is a building block of Marine Geology. Studying this subject is essential to: (i) achieve a comprehensive understanding of how the marine (sedimentary) basins operate and evolve through time; and (ii) unravel the complex interactions between the sediments and the climatic and/or tectonic processes that contribute to shape the Earth's surface. Sedimentology pertains to the study of the marine sediments and of the processes that govern their formation, such as erosion, transport, deposition, and diagenesis.

The course contributes essential insights into the methods and analytical technics that are most commonly used in the study and recognition of the different types of sediments and sedimentary rocks. These are key for the analysis of the sedimentary facies and sequences, for their paleoenvironmental interpretation (e.g., palaeoclimatology, palaeoceanography), and for deciphering the sedimentary record and help the prospection and exploration of natural resources (e.g., petroleum, ore deposits).

The course also sheds light on the importance of the marine sediments and on their relationship with the physical, chemical, biological, and hydrodynamic processes that shape the Earth's surface and control the dynamics of the ocean basins on a range of timescales. It is therefore essential to identify those processes that arise from anthropogenic activity versus those that exclusively reflect natural processes.

Through the knowledge of the sedimentary record, the sedimentology course contributes critical knowledge of the past processes, ongoing evolution, and expected future trends of the marine environment due to changes in the natural and/or anthropogenic forcing. This is central to the understanding and management of the environment that surrounds us, such as the marine and costal environments that are targeted by the courses of the following semester, as well as the Geological Oceanography I and II of the following year. This basic knowledge will be then expanded and applied in the optative course 'Basin Analysis' that students can choose in the following year.

Competencies

Code	
A5	Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
B1	Know and use vocabulary, concepts, principles and theories related to oceanography and apply everything learned in a professional and/or research environment.
B2	Plan and execute surveys in the field and laboratory work, applying basic tools and techniques for sampling, data acquisition and analysis in the water column, sea bottom and marine substratum.

- B3 Recognize and implement good practices in measurement and experimentation, and work responsibly and safely both in field surveys and in the laboratory.
- B4 Manage, process and interpret the data and information obtained both in the field and in the laboratory.
- C1 know at a general level the fundamental principles of sciences: Mathematics, Physics, Chemistry, Biology and Geology.
- C12 Acquire knowledge about processes and products related to internal and external geological cycles.
- C13 Acquire the basic sedimentological, geochemical and geophysical techniques and methodologies used in identification, use and sustainability of the natural resources of coastal and marine environments.
- C14 Know basic concepts and events of global change obtained from geological records.
- D1 Develop the search, analysis and synthesis of information skills oriented to the identification and resolution of problems.
- D2 Acquire the ability to learn autonomously, continuously and collaboratively, organizing and planning tasks over time.

Learning outcomes

Expected results from this subject	Training and Learning Results			
Recognise and identify the processes of physical and chemical weathering and their connection with sediment composition;	A5		C1 C12 C13	
2. Develop a basic knowledge of principles in sediment dynamics and master the concepts of erosion, transport, and deposition of (mostly siliciclastic) sediments;	A5		C1 C12 C13	
3. Characterise sediment's texture and mineralogy;	A5		C1 C13	
4. Recognise and identify the most common sedimentary structures in (mostly) siliciclastic settings;	A5		C13	
5. Identify the relationship(s) between sedimentary structures and depositional processes;	A5		C12 C13	
6. Comprehend the relationship between chemical weathering and seawater chemistry and characterise the exchange of (geo)chemical properties between the land, the ocean, and sediments on the seafloor;	A5	B1	C1 C12 C13	
7. Understand carbonate minerals, the basic chemistry of the carbonate system, and the carbonate factory;	A5	B1	C1 C12 C13	
8. Identify post-depositional alterations, i.e., the diagenesis of (e.g., siliciclastic, carbonate) sediments and understand the tools available to decipher diagenetic processes;	A5		C1 C12 C13	
9. Recognise and identify the different types of sediments;	A5		C12 C13	D1
10. Interpret the sedimentological data and understand the difference between how siliciclastic sediments and carbonate sediments are formed;	A5		C1 C12 C13	D1
11. Develop an understanding of the factors that control sedimentation in the marine environment;	A5	B1	C1 C12 C13	D1
12. Comprehend the concepts of facies, depositional environment, and sedimentary sequence;	A5		C1 C12 C13	D1
13. Use the sedimentological analysis to decipher the dynamics and evolutive trends of the sedimentary environment(s);	A5		C1 C12 C13 C14	D1
14. Become skilled in applying the analytical and investigative methods to perform sedimentological work in the marine environment;	A5	B2 B3 B4	C13	D1 D2
15. Apply the knowledge developed during the course to address (sedimentological) problems in the marine environment.		B4	C13	D1 D2

Contents

Topic

Topic 0. Presentation of the subject	<ul style="list-style-type: none"> 0.1. Aims of the course; 0.2. List of lectures and topics addressed by the course; 0.3. List of Laboratory seminars and practical; 0.4. Fieldwork; 0.5. Tests; 0.6. Tutorials; 0.7. Assessment; 0.8. Etiquette.
Topic 1. Basic concepts	<ul style="list-style-type: none"> 1.1. Sediments and sedimentary rocks and their relevance to other disciplines; 1.2. The geological cycling of sediments and rocks; 1.3. Sediment source, routing, and sink; 1.4. Sediment residence time; 1.5. Interplay between tectonics, climate, biology, geochemistry, and the formation and deposition of sediments.
Topic 2. Methods	<ul style="list-style-type: none"> 2.1. Overview of the methods used to collect sediment samples and investigate the formation, erosion, transport, deposition, and diagenesis of sediments in the marine realm and their lithification into sedimentary rocks; 2.2. Sampling campaigns: strategy and planning; 2.3. Characterization of sediments based on: (i) physical; (ii) chemical; and (iii) other properties; 2.4. Examples and case studies.
Topic 3. Rock weathering and the transport of solid and solute load into the ocean	<ul style="list-style-type: none"> 3.1. Water-rock interaction: chemical and physical breakdown of rocks at the Earth's surface; 3.2. Mechanisms, rates, and extent of weathering and its interactions with climate and tectonics; 3.3. Weathering products and the transport of solid and solute load into the ocean; 3.3. Impacts of weathering on ocean chemistry.
Topic 4. Siliciclastic sediments I: general fluid flow characteristics	<ul style="list-style-type: none"> 4.1. Transport environments; 4.2. Physical properties of fluids; 4.3. Relevant concepts of fluid dynamics, such as the laminar and turbulent flows, the boundary layer, and the bottom effects; 4.4. Types of flow: (i) unidirectional; (ii) oscillatory; (iii) gravitational; and (iv) liquefied.
Topic 5. Siliciclastic sediments II: sediment transport and bedforms	<ul style="list-style-type: none"> 5.1. Forces acting on a sediment particle: the Bernoulli effect; 5.2. Sedimentologically significant types of flows: the Reynolds Number; 5.3. Entrainment and transport: shear stress; boundary layer; and viscous sublayer; 5.4. Deposition: the Stokes' law. Transport modes: the Hjülstrom's and Shields' curves; 5.5. Bedforms under unidirectional flows: (i) terminology; (ii) sequence of formation; and (iii) stability; 5.6. Cross-stratification: (i) types; (ii) bedforms under oscillatory flows; (iii) stability; and (iv) relationships with the flow regime; 5.7. Other bedforms.
Topic 6. Siliciclastic sediments III: description and classification	<ul style="list-style-type: none"> 6.1. Description: texture and structure; 6.2. Classification according to the grain size; 6.3. Shape; 6.4. Origin and composition; 6.5. Classification according to the sediment composition; 6.6. Concepts of textural and compositional maturity; 6.7. Diagenesis of siliciclastic sediments and lithification into siliciclastic sedimentary rocks.
Topic 7. Siliciclastic sediments IV: grain-size distribution and fabric of siliciclastic sediments	<ul style="list-style-type: none"> 7.1. Grain-size analysis and statistics: theory and practical examples; 7.2. Fabric and texture; 7.3. Porosity and permeability; 7.4. Structures unrelated to flows: biological; postsedimentaries; diagenetic; 7.5. Bedform interpretation: temporal and spatial scales of the siliciclastic sedimentary processes.

Topic 8. Chemical and biochemical sediments I: ocean chemistry and (bio)chemical sedimentation	8.1. Processes that control ocean chemistry and its evolution through time; 8.2. Relationship between (bio)chemical sediments, climate, and weathering; 8.3. Ocean carbonate chemistry: carbonate species and carbonate precipitation in seawater; 8.4. Carbonate minerals; 8.5. Carbonate saturation, lysocline, and carbonate compensation depth and their evolution through time in connection with weathering and sea-level changes.
Topic 9. Chemical and biochemical sediments II: description and classification of carbonate sediments	9.1. Allochemical carbonate constituents; 9.2. Orthochemical carbonate constituents; 9.3. Classification of carbonate sediments and rocks and their sedimentary environments; 9.4. Diagenesis of carbonate sediments and lithification into carbonate rocks.
Topic 10. Chemical and biochemical sediments III: carbonate sedimentary environments	10.1. Carbonate production and factory; 10.2. Depositional systems: from shallow water settings to the deep ocean; 10.3. Physical processes that control carbonate production and facies distribution in the ocean; 10.4. Chemical processes that control carbonate production and facies distribution in the ocean; 10.5. Case studies from modern environments.
Topic 11. Chemical and biochemical sediments IV: siliceous, evaporitic, and other (bio)chemical sediments	11.1. Siliceous sediments; 11.2. Evaporitic sediments; 11.3. Other (bio)chemical sediments.
Topic 12. Sediment accumulation through space and time	12.1. The contribution of siliciclastic, carbonate, and other sediments to the sedimentary record and their relationship with the various oceanic, climatic, and tectonic settings; 12.2. How sediments fill a basin: basic concepts of sequence stratigraphy; 12.3. How sediment bodies are defined: basic concepts of sedimentary facies and facies types.
Seminars	Seminar 1. grain size and composition; Seminar 2. sediment transport; Seminar 3. Seawater chemistry and carbonate deposition.
Laboratory practical	Optical sedimentary petrology.
Fieldwork	Fieldtrip 1. Southern Margin of the Ría of Vigo; Fieldtrip 2. Galician beaches of Montalvo and Pociñas.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	25	44	69
Studies excursion	15	10	25
Laboratory practical	5	7	12
Mentored work	0	20	20
Seminars	7	17	24

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Lectures on the 12 topics of the program. Coverage of the topics will be flexible to address questions and issues that may arise over the duration of the course.
Studies excursion	It includes the 2 fieldtrips of 7 hours each, which are aimed at carrying out direct observations on specific sedimentary environments and evaluate their main sedimentological features.
Laboratory practical	5 hours of laboratory practical, using a petrographic microscope as a fundamental tool to perform petrographic investigation of sediments and sedimentary rocks.
Mentored work	Reports to be presented after seminars, laboratory practicals, and fieldtrips.
Seminars	Seminars of 2:20 hours each in the laboratory, during which main analytical techniques and approaches are illustrated and applied.

Personalized assistance

Methodologies Description

Lecturing	Questions and doubts that may arise during lectures will be addressed during tutorials. Tutorials will take place on Monday to Friday between 13:00 to 14:00, unless the professor has other commitments and duties that cannot be either cancelled or postponed. Students and/or group of students that are willing to attend the tutorials should contact the professor well in advance in order to efficiently schedule the tutorial.
Mentored work	Questions and doubts related to the mentored work will be addressed during tutorials. Tutorials will take place on Monday to Friday between 13:00 to 14:00, unless the professor has other commitments and duties that cannot be either cancelled or postponed. Students and/or group of students that are willing to attend the tutorials should contact the professor well in advance in order to efficiently schedule the tutorial.

Assessment						
	Description	Qualification	Training and Learning Results			
Lecturing	Written or oral exam that consists mostly of short questions and topical questionnaires. In addition, the exam may include questions that need to be developed more broadly, the resolution of a problem, and/or the interpretation of images and the construction of diagrams. Questionnaires after main topics will also form part of the evaluation	70	A5	B1	C1 C12 C13 C14	D1 D2
Studies excursion	Reports and/or questionnaires related to the information acquired during the fieldtrips.	5	A5	B1	C1 C12 C13 C14	D1 D2
Laboratory practical	Questionnaires related to the information acquired during the practicals	5	A5	B1	C1 C12 C13 C14	D1 D2
Seminars	Reports and/or questionnaires related to the information acquired during the seminars.	20	A5	B1	C1 C12 C13 C14	D1 D2

Other comments on the Evaluation

CALCULATION OF THE FINAL GRADES

1. GRADING FROM CONTINUOUS ASSESSMENT (70%):

- a. Field trips (10%);
- b. Seminars (30%);
- c. Topical questionnaires (30%).

2. FINAL TEST NOTE: 30%

The average of each of these sections (1a, 1b, 1c) must be ≥ 4.00 .

The maximum grade in this section can only be = 5 if the students do not sit the final exam.

Final grade: continuous assessment mark (70%) + Final exam mark (20%)

Improvement on the final grade: students who achieve a FINAL NOTE ≥ 8 will be allowed to access an oral test to improve their mark.

ATTENDANCE

Attendance at fieldtrips, seminars, and laboratory practicals is an essential requirement to be admitted to the final exam. Attendance at less than 80% of the lectures, and/or failing to take part to even one of the fieldtrips will preclude admission to the final exam.

Failing the final exam implies that none of the partial marks (i.e., those obtained for the seminar essays and fieldtrip reports) will be kept for the following academic year.

Date, time and place of the exams will be published in the official web of Marine Sciences Faculty:

<http://mar.uvigo.es/index.php/en/alumnado-actual-2/examenes-3>

The students are strongly requested to have an honest and responsible conduct.

It is considered completely unacceptable any alteration or fraud (i.e., copy and/or plagiarism) that are aimed at modifying the level of knowledge and skills acquired during the course and that are evaluated during exams, essays, reports or any kind of work requested by the course's lecturers. Fraudulent behaviour may result in failing the course for a whole academic year. An internal dossier of these activities will be made. In case of a repeat offence, the university rectorate will be asked to open a disciplinary file.

Sources of information

Basic Bibliography

Adams, A. E., **A Colour Atlas of Carbonate Sediments and Rocks Under the Microscope**, Manson, 1998

Allen, J.R.L., **Principles of Physical Sedimentology**, Netherlands: Springer, 1985

Arche, A, **Sedimentología**, Ed CSIC, 2010

MacKenzie, W. S. & Adams, A. E., **Rocks and Minerals in Thin Section: A Colour Atlas**, Manson, 1994

Schlager, W., **Carbonate Sedimentology and Sequence Stratigraphy.**, SEPM (Society for Sedimentary Geology), 2005

Tucker, M. E., **Sedimentary Petrology. An Introduction to the origin of sedimentary rocks.**, 3, Blackwell Science Ltd., 2001

Tucker, M. E., **Techniques in Sedimentology**, Blackwell Scientific Publications, 1988

Zeebe, R.E., Wolf-Gladrow, D.A., **CO₂ in Seawater: Equilibrium, Kinetics, Isotopes.**, Amsterdam: Elsevier Oceanography Series, 2001

Complementary Bibliography

<http://www.iasnet.org/>,

<http://clasticdetritus.com/>, **clastic detritus**,

<http://www.sedimentologists.org/>, **International Association of Sedimentologist**,

<http://www.aapg.org/about/petroleum-geology/geology-and-petroleum/sedimentology-and-stratigraphy#424>, **American Association of Petroleum Geologist (AAPG)**,

Recommendations

Subjects that continue the syllabus

Coastal and marine sedimentary habitats/V10G061V01207

Subjects that are recommended to be taken simultaneously

Mathematics: Mathematics II/V10G061V01109

Subjects that it is recommended to have taken before

Geology: Geology 1/V10G061V01103

Geology: Geology 2/V10G061V01108

Other comments

REMINDER: GRADING INSTRUCTIONS

It is emphasized that attendance at lectures, seminars, and laboratory practicals is mandatory. Should attendance to these activities be less than 80% the student will not be allowed to sit the final exam. Fieldwork activities are also mandatory and 100% attendance is in order.

Every student must reach at least 40% mark in each of the activities to be able to pass the exam.

None of the marks will be kept for the following academic year.

DELIVERY FORMATS

Unless otherwise stated, all submissions must be made electronically by uploading the documents in the form of PDFs to the TEMA platform. Accordingly, submissions by email and/or in paper will not be accepted or assessed.

DEADLINES

It is important to bear in mind that submission deadlines must be met by each of the students and for each of the activities of the course, and deadline extensions will not be allowed. Every submission must be made within one week of completion of the relevant activity. All deadlines expire at 23:59 of the day that is indicated in the TEMA platform. No submission will be accepted nor evaluated beyond the submission deadline.

AUTHORSHIP

Submission of any teamwork is responsibility of the student who has been designed as the coordinator of the team. The coordinator takes full responsibility of overseeing the number of co-authors (if a limit is set) of the essay, the contribution of each co-author (if any is repeated or missing) of the essay, and of ensuring that the deadline of submission of the essay is met.

No authors can be added after the essay has been submitted.

Authors that appear in more than one essay will not be accepted.

Plagiarized papers, either in full or in part, will not be accepted.

THE PLATFORM TEMA IS THE FORMAL METHOD OF COMMUNICATION

What is stated in the communications made via the TEMA platform will always prevail over any other form of communication.

HONORABILITY

It is expected that the students who attend this course will have a responsible and honest conduct.

It is deemed inadmissible any form of fraud (e.g., copy and/or plagiarism) aimed to alter the level of knowledge or skills achieved by a student in any type of test, essay, or report. This fraudulent conduct will be punished with firmness and rigor established in current regulations.

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===

Given the uncertain and unpredictable evolution of the health alert caused by COVID-19 pandemic, the University of Vigo establishes an extraordinary plan that will be activated when the the regional and national governments and of the university itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===

* Teaching methodologies maintained

Lecturing contents will stay the same as for campus-based lectures, while the lectures themselves will be entirely or partly moved online using CampusRemoto (<https://campusremotouvigo.gal>) and complemented where needed with additional literature material.

* Teaching methodologies modified

Fieldtrips will be replaced by videos y photographs of Galician beach environments to illustrate the sedimentary processes in coastal areas.

Microscope photographs of sediment samples and sedimentary rock thin sections will be used to illustrate the petrographic differences of different sediments and sedimentary rocks.

Videos will be used to illustrate the laboratory component of the seminars, while synthetic datasets will be used to calculate settling and deposition of siliciclastic sediments and chemical conditions for carbonate sediment deposition.

* Non-attendance mechanisms for student attention (tutoring)

Entirely or partly moved online using CampusRemoto.

* Modifications (if applicable) of the contents

Contents will stay the same as for campus-based teaching.

* Additional bibliography to facilitate self-learning

None.

* Other modifications

None.

=== ADAPTATION OF THE TESTS ===

* Tests already carried out

Topical questionnaires: [Previous Weight 30%] [Proposed Weight 30%]

Seminars: [Previous Weight 30%] [Proposed Weight 30%]

Field trips: [Previous Weight 10%] [Proposed Weight 10%]

Final Test: [Previous Weight 30%] [Proposed Weight 30%]

The grading process by continuous assessment will be the same as in the campus-based learning, regardless of whether teaching will be moved entirely online or partly campus-based, as stated in the contingency plan of the teaching subject guides DOCNET.

* Pending tests that are maintained

Topical questionnaires: [Previous Weight 30%] [Proposed Weight 30%]

Seminars: [Previous Weight 30%] [Proposed Weight 30%]

Field trips: [Previous Weight 10%] [Proposed Weight 10%]

Final Test: [Previous Weight 30%] [Proposed Weight 30%]

* Tests that are modified

[final exam] => [oral test]

The final exam will consist exclusively an oral test. It will be the only form of evaluation available to those who have not obtained a ≥ 5 mark in the continuous assessment. The final grade will be based exclusively on this test. Students who have obtained a mark ≥ 5 in the continuous assessment, may take the oral exam to improve their grade: In this case the average of the continuous part would be done as long as the mark in the oral test ≥ 4 .

* New tests

Final oral test

* Additional Information

None
