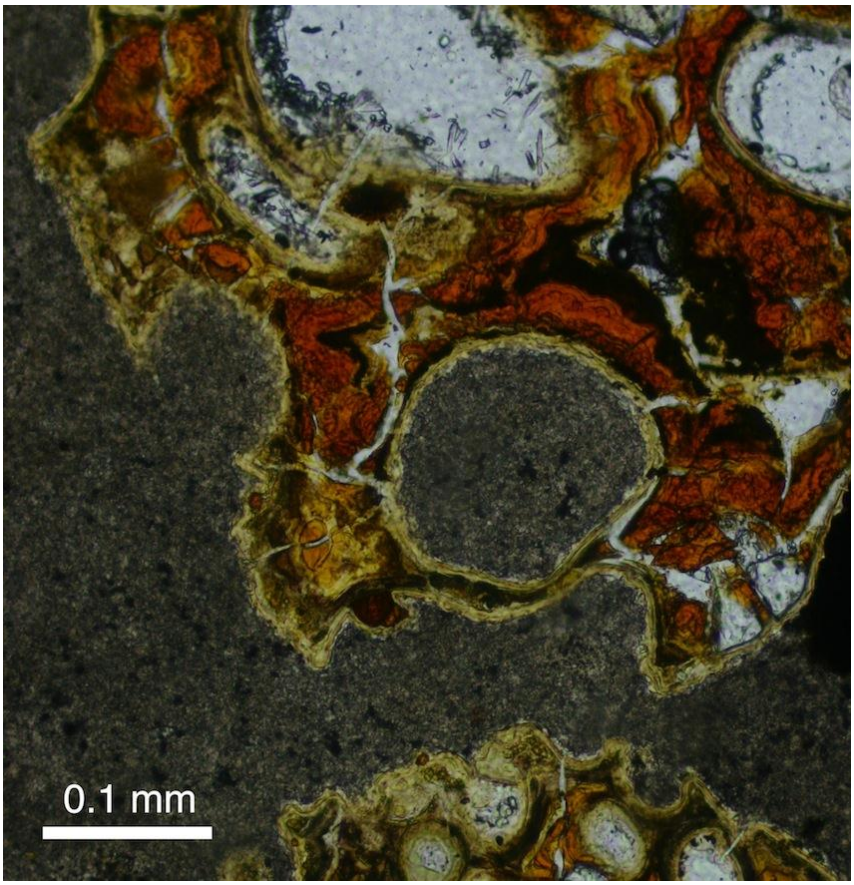
MACQUARIE UNIVERSITY
SYDNEY ~ AUSTRALIA

FACULTY OF SCIENCE

DEPARTMENT OF EARTH AND PLANETARY SCIENCES



GEOS206
MARINE DEPOSITIONAL ENVIRONMENTS

Semester 1 2011

Cover photo: Basaltic hyaloclastite from the Lord Howe Rise. The angular and vesicular clasts of basalt are in a matrix of calcareous ooze.

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Credit Points: 3

Contact hours: Lectures – 2 x 1 hr (E5A 107 on Wednesday at 11.00 am; E5A 119 on Thursday at 11.00 am)
Mixed class - 2 hr (Wednesday or Thursday 2-4 pm E5A 132)

Pre-requisites: GEOS125/GEOS115 or GEOS126/GEOS116

INTRODUCTION

This unit is divided into 4 modules that cover sedimentation and magmatic processes in the marine environment. The modules are:

1. Methods of analysis
2. Passive margin processes
3. Ocean island volcanoes
4. Deep marine processes

1. Methods of analysis

This module is an introduction to methods used to understand past and present marine depositional environments. The methods covered are those used in the analysis of siliciclastic and volcaniclastic sediments and sedimentary and igneous rocks. The analysis starts with small-scale features of sediment and volcanic particles, and moves upwards in scale to include methods used for hand specimen analysis, outcrops, continuous sections and basins. Recent advances in sedimentary and igneous rock analysis involve the use of isotopes to date marine sediments and rocks and to understand processes in the marine environment. This module is divided into two sections; one part comes at the start of the unit covering skills that will be needed in later modules, the other comes at the end of the unit and covers aspects that build on earlier concepts and integrate the content of the unit.

2. Ocean island volcanoes

Ocean island volcanoes occur in two main tectonic settings: as hot spot volcanoes and island arc volcanoes. Both build up from the ocean floor in subaqueous environments allowing interaction between the hot magma and seawater. As volcanoes almost reach the sea surface, the reduced water pressure leads to a number of hydroclastic volcanic and sedimentary processes. Mature volcanic arcs develop a thick crust and allow the formation of more silicic magmas. This module will include both igneous and sedimentary processes in the marine environment and introduce a number of rocks formed in these settings.

3. Passive margin processes

Passive margins occur at the junction of continental and oceanic crust at sites where there are no active tectonic processes (eg no subduction). Such margins are the sites of active sedimentation in a range of settings from shallow marine (transitional to terrestrial) to deep water environments. The nature of the sediment depends largely on the geology and landscape of the adjacent continent and the interaction and strength of marine currents. The accumulation of sediment on passive margins is often conducive to the formation of oil and gas deposits. This module concentrates on using the modern environment as a model for the ancient.

4. Deep Marine Processes

The deeper parts of ocean basins are less well studied than many other areas. Processes include volcanic eruptions at the mid-ocean ridge (MOR) and the development of oceanic lithosphere. As lithosphere cools and moves away from the ridge it becomes covered by sediment characteristic of the abyssal depths. The heat at the ridge drives a hydrothermal circulation system that can lead to the formation of metal sulphide-rich deposits. Some of these deposits may be economic to mine in the near future and others give clues to how many ore deposits that are now part of marine sedimentary sequences may have formed. This circulation also changes the composition of the oceanic crust and can lead to the formation of metamorphic rocks. Oceanic lithosphere is eventually recycled at subduction zones. The subducted slab includes water and sediment and its passage into the mantle leads to melting and the production of new magma. The environment at a subduction zone is referred to as the "subduction factory" to highlight this as a system involving inputs and outputs. Recent exploration of the deep sea floor has solved many puzzles but also had unexpected results. This module looks at the volcanic and sedimentary processes involved in the formation of new oceanic lithosphere and how the lithosphere changes over time.

Teaching sessions include lectures, practical sessions, research project workshops, and an excursion to the NSW south coast during the break. We aim to provide an integrated learning environment bringing together the background information and practical skills needed for the interpretation of both modern and ancient marine depositional environments. There are a number of research projects that include a group work component.

The unit provides a strong foundation for third year Earth and Planetary units as well as the geological framework and field and laboratory skills needed in a range of other Earth and environmental units.

KEY LEARNING OBJECTIVES

At the completion of this unit, you will have further developed:

1. understanding of the tools and methods that are used in the geosciences;
2. competence in applying geoscientific principles to understanding the world around you;
3. capacity to employ appropriate geoscientific tools to solve problems and to intepret the results;
4. understanding scientific methodology;
5. competence in accessing, using and synthesising appropriate information;
6. application of knowledge to solving problems and evaluating ideas and information;
7. team work skills; and
8. capacity to present ideas clearly with supporting evidence.

STUDY PROGRAM

Lectures: are held in E5A 107 on Wednesday at 11.00 am and in E5A 119 on Thursday at 11.00 am.

Practical exercises and research project workshops: are held in room E5A 132. You are required to attend on Wednesday or Thursday 2.00 - 4.00 pm.

EXCURSIONS

During this unit of study you will be required to participate in an extended field trip to the NSW South Coast. Fieldwork will be done from Monday 11 April to Friday 15 April, and is a vital part of the unit; attendance is therefore compulsory. A range of marine depositional environments, both modern and ancient, will be studied in the field.

Each student is required to pay with the accommodation payment form to the Cashier, Macquarie University by Wednesday 9 March the full amount of accommodation (excluding food) costs as a non-returnable deposit. An official University receipt will be issued.

Details of the trip and cost will be given out separately.

GRADUATE CAPABILITIES

Students will enter a globalizing world of major environmental change and resource constraints, of scientific and technological advance and ethical challenge, of continuing political instability and possible international conflicts, of unlimited creativity and increasing social surveillance. To prepare students for life after university, various graduate capabilities are developed through the curriculum. These capabilities are described below.

No.	Capability	Brief Description
1	*Discipline Specific Knowledge and Skills*	Graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession.
2	*Critical, Analytical and Integrative Thinking*	Graduates are to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments.
3	*Problem Solving and Research Capability*	Graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge.
4	*Creative and Innovative*	Graduates will be capable of creative thinking and of creating knowledge.
5	*Effective Communication*	Students develop the ability to communicate and convey their views in forms effective with different audiences.
6	*Engaged and Ethical Local and Global*	Graduates will have respect for diversity, to

	citizens	be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy.
7	*Socially and Environmentally Active and Responsible*	Graduates to be aware of and have respect for self and others.
8	*Capable of Professional and Personal Judgement and Initiative*	Graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement.
9	*Commitment to Continuous Learning*	Graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake.

ASSESSMENT

The assessment consists of several components, listed below. A satisfactory standard is required in all components.

Assessment tasks:

Task	**Weight**	**Linked learning outcome**	**Linked graduate capability**
Research projects	30%	1, 2, 3, 4, 5, 6, 7, 8	1, 2, 3, 4, 5, 7, 8, 9
Fieldwork (field book and tutor's participation mark)	14%	1, 2, 3, 4, 5, 6, 7, 8	1, 2, 3, 4, 5, 6, 7, 8, 9
Quizzes	6%	1, 2, 6	1, 2
Practical exam	10%	1, 2, 3, 5, 6	1, 2, 3, 5
Final examination	40%	1, 2, 3, 5, 6	1, 2, 3, 5

Research Project Reports:

Two (2) research projects will be completed during the semester. The topics for these will be given during the semester. The aim of the research projects is to exercise your skill in analysing and interpreting marine depositional environments. These projects will usually extend over 3 – 4 weeks and will resemble the investigations that scientists face in the real world, with many interacting factors and a number of possible solutions. We will also complete class exercises in some practical classes.

You will be working in small teams for each research project, both in attempting to solve the problem and to produce a final report. The reports will be awarded a pass/fail grade for your group work and marks for your individual synthesis. Each member of the team will be expected to do substantial research outside of class time (e.g. library and/or web-based literature search). Each of the research projects will allow you to explore the ideas in depth

and will provide an effective and, we hope, enjoyable method of learning. There is also the added benefit of providing you with opportunities to develop your abilities in problem-solving, team work, communication, accessing and evaluating information and in using scientific approaches to solve problems.

In marking the research project reports, we shall use three broad criteria:

(1) competence in analysis and interpretation;
(2) clear and concise expression of your thoughts; and
(3) originality.

Each project will also have a number of specific marking criteria that will be listed with the project outline.

Referencing:

All submitted work must include clear and correct referencing. The extent and quality of your referencing will be included within the communication portion of the marks awarded to each report.

Quotations should be used only if the point being made is vital to your argument and if you could not express it better yourself. If you paraphrase, you must acknowledge your authority as you would when quoting directly -- after the paraphrased section or quotation, i.e. (Smith, 1981, p.132). Make sure you document this reference in your list of References. Remember, **plagiarism is cheating!**

All references must be clearly documented at the end of your report. For a book, the information expected is: Author(s), year of publication, title, edition (if not 1st), publisher, place of publication.

> *e.g.* Skinner, B.J. and Porter, S.C., 2000. The Dynamic Earth. J. Wiley & Sons, Inc., New York. (4th edition)

For a journal article, give: author(s), year of publication, title, name of journal, volume number, page numbers.

> *e.g.* Gaul, O.F., Griffin, W.L., O'Reilly, S.Y. and Pearson, N.J., 2000. Mapping olivine composition in the lithospheric mantle. Earth and Planetary Sciences 182, 223-235.

For a journal article on the WWW give: author, year, 'article title', name of journal, volume number, viewed Day Month Year, <URL>.

For a web document give: author/editor or compiler, year of the most recent version, title, version number (if applicable), description of document (if applicable), name and place of the sponsor of the source, viewed Day Month Year, <URL either full location details or just the main site details>.

For more details on referencing of material from the www see:
< http://www.usq.edu.au/library/help/ehelp/ref_guides/harvardonline.htm >

Dates for submission of assessment tasks:

The sequence and the deadlines for receipt of the assignments are:

Research Project 1	9.00am	Thursday 31st March
Research Project 2	9.00am	Thursday 12th May

5% will be deducted for each day or part of a day that reports are received after the deadline. Extensions for late reports will be granted only if misadventure (including incapacitating sickness) can be demonstrated.

Students must keep a photocopy of their reports.

Submission of Research Project Reports:

All reports must be submitted either by 9.00 am on the date specified to the appropriate box for GEOS206 in the reception area of the Science Centre (Room 101) which is on the ground floor at the western end of building E7A, or to the class convenor during the practical session. The Science Centre opens from 8.30am to 5.30pm on Monday to Friday.

All reports must include a completed and signed coversheet stapled to the front cover. The Assignment Cover Sheet can be downloaded from http://www.science.mq.edu.au/documents/FoS_assignment_coversheet_11.pdf.

Effect of excessive paid work and other activities on student progress and success:

Several studies on student progress have demonstrated that excessive hours of paid work and/or other activities, especially regular commitments, can have a detrimental effect on successful completion of studies. As stated in the Undergraduate Handbook the number of credit point for each unit reflects the amount of work required, and each credit point has an expectation of 3 hours of work (this includes both in class and out of class study).

If you are undertaking an average full-time program of study, i.e. 12 credit points, then you should expect to undertake 36 hours of work. Care should be taken with additional regular commitments to ensure that you are not overloading yourself. Options might include cutting back on outside commitments during the semester or reducing the number of units you undertake.

Queries and appeals

In the first instance, contact one of the unit convenors if there are any questions about the assessment tasks themselves, or about the comments and grades that you receive for your reports. You are permitted to appeal against your final grade in any of your units. Before initiating an appeal, discuss your unit grade fully with the Unit convenor. More details of the appeals procedures are available in the Science Centre E7A.

Desired Standards

Grade	Standard Required
High Distinction	Demonstrates an extensive knowledge and understanding of the concepts of the course.
Distinction	Demonstrates a thorough knowledge and understanding of the concepts of the course.
Credit	Demonstrates a sound knowledge and understanding of the concepts of the course.
Pass	Demonstrates a basic knowledge and understanding of the concepts of the course.
Conceded Pass	Demonstrates a limited knowledge and understanding of the concepts of the course.
Fail	Demonstrates a poor knowledge and understanding of the concepts of the course.

The Dangers of Plagiarism and how to avoid it

The integrity of learning and scholarship depends on a code of conduct governing good practice and acceptable academic behaviour. One of the most important elements of good practice involves acknowledging carefully the people whose ideas we have used, borrowed, or developed. All students and scholars are bound by these rules because all scholarly work depends in one way or another on the work of others.

Therefore, there is nothing wrong in using the work of others as a basis for your own work, nor is it evidence of inadequacy on your part, provided you do not attempt to pass off someone else's work as your own.

To maintain good academic practice, so that you may be given credit for your own efforts, and so that your own contribution can be properly appreciated and evaluated, you should acknowledge your sources and you should ALWAYS:

1. State clearly in the appropriate form where you found the material on which you have based your work.
2. Acknowledge the people whose concepts, experiments, or results you have extracted, developed, or summarised, even if you put these ideas into your own words.
3. Avoid excessive copying of passages by another author, even where the source is acknowledged. Find another form of words to show that you have thought about the material and understood it, but remember to state clearly where you found the ideas.

If you take and use the work of another person without clearly stating or acknowledging your source, you are falsely claiming that material as your own work and committing an act of PLAGIARISM. This is a very serious violation of good practice and an offence for which you will be penalised.

YOU WILL BE GUILTY OF PLAGIARISM if you do any of the following in an assignment, or in any piece of work which is to be assessed, without clearly acknowledging your source(s) for each quotation or piece of borrowed material:

1. Copy out part(s) of any document or audio-visual material, including computer-based material.
2. Use or extract someone else's concepts or experimental results or conclusions, even if you put them in your own words.
3. Copy out or take ideas from the work of another student, even if you put the borrowed material in your own words.
4. Submit substantially the same final version of any material as a fellow student. On occasions, you may be encouraged to prepare your work with someone else, but the final form of the assignment you hand in must be your own independent endeavour.

Feedback on assessment tasks:

Feedback on assessment tasks is given in this unit in the following ways:

1. Our primary mode of assessment feedback: the assessment marker will present overall feedback to the class, at either a lecture, tutorial or practical class, on what aspects of the assessment task were done best and where improvement is needed in general.
2. Students are strongly encouraged to seek further feedback (at the time it is given or by making an appointment with the assessment marker) if they are unsure of any aspect of the feedback or if they want further feedback.

3. We provide you with a checklist of what is asked in the assessment task and a breakdown of the marks awarded for each component. Scoring full marks for a given component indicates that you did exceptionally well. Alternatively, scoring poorly in a component strongly suggests it required further work.
4. In the instance of scoring very poorly overall, you will be provided with written feedback on the assessment task indicating where you could improve.

Quizzes:

The weekly quiz will begin in week 2 and will be completed and marked online. The quiz will examine the lecture and practical topics of the previous week as well as the research projects.

Final examination:

The final exam will cover material from the lectures, field trip, class exercises and research project reports. Questions will draw on information and ideas from different areas to give an integrated view of the unit. The exam will include questions that ask you to apply your knowledge to interpret and solve problems.

TEXTS AND REFERENCES

Unit text: NICHOLS, G. 2009. Sedimentology and stratigraphy. 2nd Edition. Blackwell Science, Malden, Mass.

Reference books: References held in the Library Reserve, are:

BEST, M.G., 2003. Igneous and metamorphic petrology. Blackwell Publishing, Malden, MA. 2nd ed. QE461 .B53 2003.

BLATT, H. and TRACY, 1996. Petrology: igneous, sedimentary and metamorphic. Freeman & Co. QE 431.2.B57.

COLLINSON, J., 2005. Sedimentary structures. Terra.

ERNST, W.G. 1969. Earth Materials. Prentice-Hall. QE364.E72.

GIFKINS, C. HERRMANN, W. AND LARGE, R., 2005. Altered volcanic rocks: a guide to description and interpretation. Centre for Ore Deposit Research, University of Tasmania. QE390.5 G54

HATCH, F.H. 1972. The Petrology of Igneous Rocks. Murby. QE 461.H3.

HERBERT, C.AND HELBY, R., 1980. A guide to the Sydney Basin. Geological Survey of NSW, Bulletin 26, Department of Mineral Resources. QE341 .N4/VOL 26

JOHNSON, D., 2004. Geology of Australia**.** Cambridge.

McPHIE, J., DOYLE, M. and ALLEN, R. 1993. Volcanic Textures. CODES Key Centre, University of Tasmania. QE 461.M36.

READING, H.G. (ed.) 1996. Sedimentary environments: processes, facies and stratigraphy, 3rd Ed. Blackwell, Oxford, 688 pages. QE 471.S378/1996.

SCHMINCKE, H-U., 2004. Volcanism. Springer. QE522 .S295

SELLEY, R.C. 1996. Ancient Sedimentary Environments and their subsurface diagnosis. Chapman and Hall, London, 300 pages. QE471.S42/1996.

VERNON, R.H. 1976. Metamorphic Processes: reactions and microstructure. Murby. QE 475.A2.V4.

WALKER, R.G. AND JAMES, N.P. (eds) 1992. Facies models : response to sea level change. Geological Association of Canada, St. John's, Nfld. : QE651 .F282

WHITE, J.D.L., SMELLIE, J.L. AND CLAGUE, D.A. (eds) 2003. Explosive subaqueous volcanism. American Geophysical Union, Washington, D.C. QE511.7 .E97

WINTER, J.D., 2001. An introduction to igneous and metamorphic petrology. Prentice Hall, Upper Saddle River, NJ. QE461 .W735/2001

WEB ACCESS

Further information on this unit can be accessed through >http://online.mq.edu.au/<.

Week	Date	Lecture/Assignment	Practical / Research Project	Text Reference
Module 1 **Methods of analysis**				
1	Wed 23 February	Introduction to GEOS206	Sedimentary structures	Chapters 4 and 17
	Thurs 24 February	Introduction to methods of analysis 1		Chapters 1, 2 and 3
2	Wed 2 March	Introduction to methods of analysis 2	Sedimentary core logging and facies descriptions	Chapters 1, 5, 18, 21 and 22
Module 2 **Growth and destruction of oceanic volcanoes**				
	Thurs 3 March	Sub-aqueous volcanism		Chapters 3, 15 and 16
3	Wed 9 March	Ocean island volcanoes: relationship to tectonics **Research Project 1 handed out**	Research Project 1 introduction; Minerals and Igneous Rocks – basalt and andesite	Chapters 15 and 16
	Thurs 10 March	Products of silicic volcanism		Chapters 3 and 16
4	Wed 16 March	Sedimentary processes at ocean island volcanoes	Research Project 1; Minerals and Igneous Rocks – dacite and rhyolite	Chapters 16 and 23
	Thurs 17 March	Carbonates 1		Chapter 3
5	Wed 23 March	Carbonates 2	Research project 1; Chemical Data	Chapter 14

Module 3 **Processes at passive margins**				
	Thurs 24 March	What are passive margins?		Chapters 6,9 and 23
6	Wed 30 March	Deltas **Research Project 2 handed out**	Research Project 2 introduction; Palaeo-geographic reconstructions from graphic logs	Chapter 12
	Thurs 31 March	Linear clastic shorelines **Research Project 1 due**		Chapters 11 and 13
7	Wed 6 April	Continental shelf	Research Project 2; Reconstruction of past environments using trace fossils	
	Thurs 7 April	Continental slope and rise		Chapter 7
		Break 11 April - 26 April **(Excursion 11-15 April)**		
8	Wed 27 April	TBA	Research Project 2	Chapter 15
	Thurs 28 April	Oil and gas in passive margin settings		Chapter 17
Module 4 **Deep ocean processes**				
9	Wed 4 May	Ophiolites as past oceanic crust	Research Project 2; Minerals and Igneous Rocks – ophiolites	Chapter 23
	Thurs 5 May	Mid ocean ridge magmatism as new oceanic crust		

10	Wed 11 May	Tectonics and the serpentinite question	Metamorphic rocks	
	Thurs 12 May	Metamorphism of the ocean lithosphere **Research Project 2 due**		
11	Wed 18 May	Deep water sedimentation	Poster assessment	Chapter 15
	Thurs 19 May	Marine environments in the development of the Tasmanides		
12	Wed 25 May	Hydrothermal systems in marine environments	Ore minerals	Chapter 15
Module 1 revisited **Methods in Sedimentary analysis**				
	Thurs 26 May	Dating the marine environment: Absolute age determinations, methods and limitations		Chapter 20
13	Wed 1 June	Using stable isotopes to understand the marine environment	Revision	
	Thurs 2 June	Practical exam		

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