



GEOS3130

Earth System History

Session 2, Weekday attendance, North Ryde 2020

Department of Earth and Environmental Sciences

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Disclaimer

Macquarie University has taken all reasonable measures to ensure the information in this publication is accurate and up-to-date. However, the information may change or become out-dated as a result of change in University policies, procedures or rules. The University reserves the right to make changes to any information in this publication without notice. Users of this publication are advised to check the website version of this publication [or the relevant faculty or department] before acting on any information in this publication.

Notice

As part of [Phase 3 of our return to campus plan](#), most units will now run tutorials, seminars and other small group learning activities on campus for the second half-year, while keeping an online version available for those students unable to return or those who choose to continue their studies online.

To check the availability of face-to-face and online activities for your unit, please go to [timetable viewer](#). To check detailed information on unit assessments visit your unit's iLearn space or consult your unit convenor.

General Information

Unit convenor and teaching staff

Convenor

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Credit points

10

Prerequisites

(GEOS206 or GEOS2130) and 120cp at 1000 level or above

Corequisites

Co-badged status

Unit description

This unit focuses on the evolution of the Earth as a system. The thin layer of sediments and sedimentary rocks at the Earth's surface contains a unique record of the planet's long history. This record reveals the gradual and at times spectacular (co)evolution of the geological, ocean, atmosphere and biological components which make the planet the complex system that it is today. An understanding of this system is critical for predicting the consequences of future climate and environmental change, the origin and distribution of the resources that are critical to society, and allows us to place modern rates of extinction into a geological context. Lectures and case studies will highlight the fascinating ways in which conditions at the Earth's surface have changed over time. Examples will include the causes and consequences of the rise in atmospheric oxygen, the invasion of land by plants and animals, the fall of the dinosaurs, periods of increased volcanism, as well as episodes of global warming and cooling. Hands-on practicals will give you the skills to read and interpret the physical, chemical and biological clues to the Earth's past, and allow you to critically assess the ongoing scientific controversies in this area. This unit is of interest to those majoring in geology, marine science, palaeobiology and environmental science.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at <https://www.mq.edu.au/study/calendar-of-dates>

Learning Outcomes

On successful completion of this unit, you will be able to:

- ULO1:** Demonstrate advanced skills in the identification, petrographic characterisation and interpretation of sedimentary rocks
- ULO2:** Apply stratigraphic principles to the correlation of sedimentary sequences
- ULO3:** Demonstrate an understanding of the links and feedbacks between the geo-, bio-, hydro- and atmosphere and how these have evolved through time
- ULO4:** Demonstrate your ability to critically appraise palaeoenvironmental proxy records, and an understanding of theoretical and empirical basis of proxies
- ULO5:** Describe the major biogeochemical cycles and their link to the climate system
- ULO6:** Apply discipline-specific knowledge to solving problems and evaluating ideas and information

General Assessment Information

Marks are awarded for the assignment, an oral presentation, on-line quizzes, a mid-term test, and the final exam. Assessment at Macquarie University is standards-based, as outlined in the Assessment Policy. This means that your work will be assessed against clear criteria, and these criteria (e.g. in a rubric) will be made available when the assessment tasks are released to you

on iLearn. There is no requirement to pass the final exam in order to pass the unit.

Requirements to complete this unit satisfactorily

To complete this unit satisfactorily, you must:

1. Participate in the scheduled workshops;
2. Complete all assessments and the final exam; and
3. Achieve a pass grade or higher.

The descriptions for grades common to all coursework units offered by Macquarie University are outlined in [Schedule 1 of the Assessment Policy](#).

On-line quizzes on workshops

After each workshop on Monday a quiz will open to make sure you have read and understood the lecture material, practical, and weekly reading. The 12 quizzes will be available on-line through the iLearn system and together are worth 10% of the unit mark. The quizzes are in each weekly section of iLearn; also see the shortcuts to all quizzes from the “Activities” panel on the right hand side of the iLearn page. You will do the quizzes in your own time, open book, and they will be open until 23:59 on the following Friday (4¹/₂ days to do each of them). The question order will be forced (i.e. you can't go back to a question later) and random, there will be a time limit of 30 mins on the workshop quizzes, and you only get one go. There is no workshop or quiz in week 13 (oral presentation day). The 10% quiz mark will be derived by summing all 12 of the lecture quizzes and normalising.

Practicals

A very important component of GEOS3130 are the practicals. These are for 3¹/₂–4 hours per week during the workshops, and enable several of the topics to be dealt with in greater depth. The mode of presentation of these practicals will vary considerably week to week. Some weeks, the practicals will be a more tutorial format, with group work and discussion. Other weeks the practicals will be more hands-on oriented. Some weeks you will be working on computers, other times on microscopes or virtual microscopes, or hard copy work sheets. You will be given specific details of what is expected for the practical when you begin each section of the class. Please bring pencils, pens, coloured pencils and a ruler to the practicals.

Mid-semester test

The mid-semester test will occur at the start of the week 7 workshop on Monday 7 September, immediately after the semester break. It will be a short test of the week 1–6 lectures, unit reading material, and practical exercises. The educational rationale for the mid-semester test is to check that you are on track in terms of your learnings from the unit.

Final Exam

The unit examination will be based on lectures, unit reading material, practical exercises, information you should have absorbed through completing the assignment and oral presentation, and any other material presented during classes. The educational rationale for the exam is to check the acquired knowledge by the students at the end of the unit. The University Examination

period in the Second Half Year 2020 is from Monday 9 November 2020 to Friday 27 November 2020. You are expected to present yourself for examination at the time and place designated in the University Examination Timetable. Details of exam conditions and timetables can be found on the [Exams and Results portal](#). The timetable will be available in draft form approximately eight weeks before the commencement of the examinations and in final form approximately four weeks before the commencement of the examinations. <http://www.timetables.mq.edu.au/>

You are advised that it is Macquarie University policy not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching session, that is, the final day of the official examination period. The only exception to not sitting an examination at the designated time is because of documented illness or unavoidable disruption. In these circumstances you may wish to consider applying for a “Disruption to Studies”. The following is a link to the University’s Special Consideration Policy, which you should read at the start of the session:

<https://students.mq.edu.au/study/my-study-program/special-consideration>

If a Supplementary Examination is granted as a result of the Disruption to Studies process, that examination will be scheduled after the conclusion of the official examination period.

There is a procedure for appealing against final unit grades, which is documented here:

<http://www.mq.edu.au/policy/docs/gradeappeal/policy.html>

We suggest that you discuss these sorts of problems with Prof. Simon George in the first instance.

Assignment

You will be given specific details of what is expected for the Earth System Science Research Report when it is released. The assignment will involve a written research report, in which your use of English and referencing the source of your ideas is important. The assignments will be released to you on iLearn in Week 3, and will be discussed in that week’s workshop.

The assignment is essay based, so skill at writing reports is important. The assignment topic must be fully researched and the report written in your own words. Cutting and pasting information from web pages is NOT acceptable. Information you obtain from other sources (brief quotes, images, ideas) must be fully referenced in the text (author, year), with references listed at the end of the essay (year, author, title, journal or link). See later in the handout for sections on **academic honesty** and **referencing**. Students who fail in these fundamental principles and basic skills may score zero for the assignment. The assignment will be submitted for turnitin checking and grademark assessment through iLearn. You will not need to produce hard copy. The assignment will be due on Friday of Week 7 at 5pm.

Macquarie University promotes student awareness of information management and information ethics. As well as training and the provision of general information, the University tackles the issue of plagiarism through use of an online plagiarism detection tool (Turnitin). This software is used in conjunction with a set of procedures to ensure its use is equitable. Turnitin automatically compares your work to the work of your classmates, previous students from Macquarie and other

universities, and with material available on the Internet, both freely available and in subscription-based electronic journals and books. The results will be sent to your lecturers, who will analyse these in reference to the University's standard Policy on Plagiarism.

Assessment Tasks

Name	Weighting	Hurdle	Due
Weekly Quiz	10%	No	Each week, Fridays at midnight
Stratigraphy & Earth System Science report	20%	No	Friday 11 September, 17:00
Earth System Evolution presentations	20%	No	Monday 2 November, 10:00
Mid-term test and final exam	50%	No	Mid semester test, 7 Sept (Week 7) 10:00. Final exam....

Weekly Quiz

Assessment Type ¹: Quiz/Test

Indicative Time on Task ²: 6 hours

Due: **Each week, Fridays at midnight**

Weighting: **10%**

Weekly online quiz covering material from lecture, practical and weekly readings

On successful completion you will be able to:

- Demonstrate advanced skills in the identification, petrographic characterisation and interpretation of sedimentary rocks
- Apply stratigraphic principles to the correlation of sedimentary sequences
- Demonstrate an understanding of the links and feedbacks between the geo-, bio-, hydro- and atmosphere and how these have evolved through time
- Demonstrate your ability to critically appraise palaeoenvironmental proxy records, and an understanding of theoretical and empirical basis of proxies

Stratigraphy & Earth System Science report

Assessment Type ¹: Report

Indicative Time on Task ²: 25 hours

Due: **Friday 11 September, 17:00**

Weighting: **20%**

Report evaluating a topical issue or fundamental concept in Stratigraphy or Earth System

Science

On successful completion you will be able to:

- Apply stratigraphic principles to the correlation of sedimentary sequences
- Demonstrate an understanding of the links and feedbacks between the geo-, bio-, hydro- and atmosphere and how these have evolved through time
- Demonstrate your ability to critically appraise palaeoenvironmental proxy records, and an understanding of theoretical and empirical basis of proxies
- Describe the major biogeochemical cycles and their link to the climate system

Earth System Evolution presentations

Assessment Type ¹: Presentation

Indicative Time on Task ²: 15 hours

Due: **Monday 2 November, 10:00**

Weighting: **20%**

Presentation addressing a range of topical questions in Earth System Science and Historical Geology

On successful completion you will be able to:

- Demonstrate an understanding of the links and feedbacks between the geo-, bio-, hydro- and atmosphere and how these have evolved through time
- Demonstrate your ability to critically appraise palaeoenvironmental proxy records, and an understanding of theoretical and empirical basis of proxies
- Describe the major biogeochemical cycles and their link to the climate system
- Apply discipline-specific knowledge to solving problems and evaluating ideas and information

Mid-term test and final exam

Assessment Type ¹: Examination

Indicative Time on Task ²: 20 hours

Due: **Mid semester test, 7 Sept (Week 7) 10:00. Final exam....**

Weighting: **50%**

Based on practical, multiple-choice and written questions covering material from lectures, practicals, readings.

On successful completion you will be able to:

- Demonstrate advanced skills in the identification, petrographic characterisation and interpretation of sedimentary rocks

- Apply stratigraphic principles to the correlation of sedimentary sequences
 - Demonstrate an understanding of the links and feedbacks between the geo-, bio-, hydro- and atmosphere and how these have evolved through time
 - Demonstrate your ability to critically appraise palaeoenvironmental proxy records, and an understanding of theoretical and empirical basis of proxies
 - Describe the major biogeochemical cycles and their link to the climate system
-

¹ If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the [Writing Centre](#) for academic skills support.

² Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

GEOS3130 is a component of the Bachelor of Marine Science, the Bachelor of Science specialisation in Earth and Environmental Sciences, and the Bachelor of Environment, major in Environmental Geoscience.

The unit will be presented in 4 broad themes:

Theme 1: Introduction to Earth System Science: The introduction to the unit will show how the Earth works as a System. Major (bio)geochemical cycles and the climate system will be introduced.

Theme 2: Physical, chemical and biological records of the past: This theme will include how the Earth's climate is influenced by the carbon cycle and feedback loops. Key thresholds and palaeotemperature history will be introduced, together with the use of isotopes and proxies for understanding the past. In this theme the physical sedimentary environment will be considered, and the concept of sequence stratigraphy will be introduced.

Theme 3: Precambrian Earth System Shifts: This theme involves a look at two major Precambrian events that changed the Earth for ever. One is the evolution of oxygenic photosynthesis which ultimately led to the Great Oxidation Event, the second are the Neoproterozoic glaciations which are connected with the radiation of animals.

Theme 4: Phanerozoic Earth System Shifts: This is the largest of our themes. The theme considers important periods in the Phanerozoic when the Earth System underwent significant change. First, we examine the Cambrian when there was a major and unique radiation of animal life. Then, in the early Palaeozoic, the land was invaded by higher plants for the first time. We also investigate the mass extinction at the end of the Cretaceous, the various hyperthermals in the Cenozoic, and the recent Pleistocene glaciations in depth.

Across all themes you will gain an understanding of sediments and sedimentary rocks, both in hand specimen and by practical microscopy, learn to consider Earth as an integrated biogeochemical system, and develop your critical thinking and communication skills.

Delivery and Resources

Classes and contact hours

Attend the five-hour workshop each week.

11 Wally's Walk, 210, Mondays, 10:00-15:00.

Each 5 hour workshop will include about 60 mins to 90 mins of mini-lectures, with the rest of the time spent on practical activities. The lecture material will mostly be delivered in small blocks, interspersed with the practicals. The mini-lectures may be at any time during the workshop, as decided by the person teaching each week. The lectures will typically give a broad overview of the topics, provide background information and introduce new ideas and concepts that link in with the practical activities. The lectures will be interactive, with questions and answers throughout. The lectures will be recorded using Echo 360 active learning (audio and screen capture), and files of the lecture graphics will also be made available through iLearn. These will be particularly useful for revision purposes.

At the moment this unit is set to be delivered with workshops on campus. It is possible that COVID-19 will disrupt these plans during semester 2. For up-to-date information from the university about precautions to take during semester 2, please visit the [Coronavirus \(COVID-19\) infection latest information pages](#).

Late Enrolments

If you enrol late in the unit, you will have already missed one or more workshops. It is your responsibility to catch up. Also, you will still be expected to submit all assignments within the remaining time.

Workload

This is a 10 credit point unit. It is anticipated that you will spend 150 hours on this unit. About 60 hours (12 weeks × 5 hours) will be spent in the weekly workshops (weeks 1–12), 5 hours in the oral presentations in week 13, and the remainder (85 hours) will be spent reviewing lecture material, completing practical work, undertaking the weekly quizzes, completing the assignment, preparing your oral presentation, and preparing for the two exams (mid-term test; final exam).

GEOS3130 prize and PESA

The Petroleum Exploration Society of Australia (PESA) prize for proficiency in the unit GEOS3130 Earth System History (value \$500) is awarded annually to the best performing student on GEOS3130. Consider joining PESA, the membership is FREE for students in 2020! They offer a variety of resources for their members including face-to face lunchtime talks (only \$10 if any run), free zoom talks, and there is the possibility of scholarships, and great networking! Simon can sponsor you as a PESA financial member if necessary. Learn more on their website:

<https://www.pesa.com.au/>

Textbook and Readings

- Earth System History, Steven M. Stanley and John A. Luczaj, 2015, Fourth Edition, Freeman/Macmillan Learning
- Macquarie Library Level 1/Level 2 QE28.3.S735 2015
- https://multisearch.mq.edu.au/primo-explore/fulldisplay?docid=MQ_ALMA21157705280002171&context=L&vid=MQ&lang=en_US&search_scope=PC_PLUS_LOCAL&adaptor=Local%20Search%20Engine&tab=books_more&query=any,contains,Earth%20System%20History&offset=0
- There are 4 copies in the library, 3 available for loan (no reserve due to COVID)
- It can also be purchased as a cheap ebook (pdf file).
- e.g. <https://collegestudenttextbook.org/product/earth-system-history-4th-edition-ebook/>, US\$13.
- Or from Macmillan: https://store.macmillanlearning.com/us/product/Earth-System-History/p/1429255269?_ga=2.230914459.529381458.1594707400-1498979216.1594707400
- Deals such as 6 month rental for \$58.99.
- Other readings will be supplied on iLearn.

Web pages and electronic resources

The main unit web page is on iLearn: <https://ilearn.mq.edu.au/login/MQ/>

Assignments, hand-outs, reading material and on-line quizzes will be available here.

iLearn Communication Tools: The unit iLearn page includes three messaging tools, the Announcements tool, the General Discussions forum and the Dialogue tool. In the Announcements Forum, the teaching staff will make unit-wide announcements. These will mostly concern administrative matters (Please note: students cannot post in this forum). All participants are subscribed to this forum. The General Discussions forum is used for messages that either everyone enrolled or selected groups in an online unit can read. Students and teaching staff can post and reply to these messages. The Dialogue tool is used for private messages between you, your lecturer and students in a unit. It is suggested that you check for new discussion and mail messages at least once every day.

Sound recordings and pdf files of the lecture components of the workshops: Sound recordings and video display capture will be available from the link in iLearn (on right hand side of page) to the Echo 360 site. Pdf files of each lecture will be available for download from the iLearn site, 1-2 days before each lecture. These will be in the weekly section, and will be available as pdf files in 2 formats: (1) colour, 1 page per slide, not suitable for printing, but ideal for looking at on your computer; and (2) no colour background, 3 slides per page (these are good for printing to bring to lectures).

Technology Used and Required

This unit will use iLearn and Echo360. See the [Instructions on how to log in to iLearn](#) and the [iLearn quick guides for students](#) which will help you:

- [Getting started](#) - Find out how to navigate and familiarise yourself with the iLearn environment.
- [Activities](#) - Learn how to effectively complete the activities required of you in iLearn.
- [Assignments and Gradebook](#) - Find out how to submit assessments and view your grades using iLearn.
- [Online study tips](#) - Studying online is a unique experience, learn how to navigate it here.
- [Discussion forums](#) - Explore the different types, and features of discussion forums in iLearn.
- [Lecture recordings](#) - Find out how to access lectures online, as well as the features available to you.

Unit Schedule

GEOS3130: Earth System History (Semester 2, 2020): Workshop Schedule

Week	Dates and Who (Mondays, 10:00-15:00)	Module	Lecture topics	Practical topics	Readings from Stanley and Luczaj
1	27 July SCG	Introduction to Earth System Science	Introduction to the Unit: web page, plagiarism, referencing. Unit guide and handout. Introduction to Earth as a System	Common sedimentary rock identification, how to assemble them into a basin history	Chapter 1
2	3 August SCL	Introduction to Earth System Science	Major (bio)geochemical cycles and the climate system	Carbon cycle, carbon isotopes, environmental change: The record of the Earth's exogenic cycle	Chapter 10
3	10 August SCL, SM	Physical, chemical and biological records of the past	Carbon Isotopes, Earth's Climate, and the Carbon Cycle (SM)	Release of assignment Causes and Consequences of Mesozoic Greenhouse World and Ocean Anoxic Events (SCL)	Chapter 6
4	17 August AA	Physical, chemical and biological records of the past	Proxies and proxy records: our eyes into the past	Proxies for measuring palaeo sea water temperatures	Chapter 10
5	24 August SCL	Physical, chemical and biological records of the past	Sedimentary environments and sequence stratigraphy	Stratigraphy and missing time	Chapter 5

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6	31 August SCG	Precambrian Earth System Shifts	Oxygenic Photosynthesis and Oxygenation History of Earth	Mass independent fractionation of sulphur isotopes and the Great Oxidation Event	Chapter 11
7	7 September SCL, SCG	Phanerozoic Earth System Shifts	The Cambrian: Triggers and Earth System consequences of a unique radiation of animal life	Mid semester test (at start of workshop; SCG) Earth System Transitions at the Proterozoic – Phanerozoic Boundary	Chapter 13
Assignment on Earth System Science Research Report due, Friday 11 September 17:00					
2 Week Recess					
8	28 September SCG	Precambrian Earth System Shifts	Neoproterozoic glaciations and animal radiation	Feedback on assignment Sedimentary petrography and diagenesis practical (week 1)	Chapter 12
9	5 October Labor Day Holiday	Phanerozoic Earth System Shifts	Animal and plant invasion of the land, and the evolution of higher plants (SCG recorded lecture)	Sedimentary petrography and diagenesis practical (week 2): Relationship of diagenetic pathways and reservoir properties to the rise of land plants (do in own time in week 8 or 9, ask SCG if need assistance)	Chapter 4 and 14
10	12 October SCL	Phanerozoic Earth System Shifts	Mass Extinction at the Cretaceous-Palaeogene Boundary – Causes and Consequences	Release of oral presentation topics Kill mechanism and carbon cycle impact of the K-Pg boundary event	Chapter 7
11	19 October AA	Phanerozoic Earth System Shifts	Ocean acidification and the Paleocene–Eocene Thermal Maxima	Cenozoic Hyperthermals, Biomagnetostratigraphy and Age-Depth Models	Chapter 17
12	26 October AA	Phanerozoic Earth System Shifts	Recent ice ages – high-frequency, high-magnitude climate shifts	Exercise: interpreting Australian climate records since the LGM	Chapter 20
13	2 November SCG, SCL, AA, SM	Oral presentations	Seminar week	Oral presentations Exam preparation, unit evaluation (SCG)	

Who: SCG = Prof. Simon George (convenor), SCL = Dr Stefan Löhner, AA = Dr April Abbott, SM = Dr Sean Murray.

Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central \(https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central\)](https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- [Academic Appeals Policy](#)
- [Academic Integrity Policy](#)
- [Academic Progression Policy](#)
- [Assessment Policy](#)
- [Fitness to Practice Procedure](#)
- [Grade Appeal Policy](#)
- [Complaint Management Procedure for Students and Members of the Public](#)
- [Special Consideration Policy](#) (**Note:** *The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.*)

Students seeking more policy resources can visit the [Student Policy Gateway](https://students.mq.edu.au/support/study/student-policy-gateway) (<https://students.mq.edu.au/support/study/student-policy-gateway>). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit [Policy Central](http://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central) (<http://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central>).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: <https://students.mq.edu.au/study/getting-started/student-conduct>

Results

Results published on platform other than [eStudent](#), (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in [eStudent](#). For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Student Support

Macquarie University provides a range of support services for students. For details, visit <http://students.mq.edu.au/support/>

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to help you improve your marks and take control of your study.

- [Getting help with your assignment](#)
- [Workshops](#)
- [StudyWise](#)
- [Academic Integrity Module](#)

The Library provides online and face to face support to help you find and use relevant information resources.

- [Subject and Research Guides](#)
- [Ask a Librarian](#)

Student Services and Support

Students with a disability are encouraged to contact the [Disability Service](#) who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the [Acceptable Use of IT Resources Policy](#). The policy applies to all who connect to the MQ network including students.

Changes from Previous Offering

Since 2019 there was a reordering of the unit content. The mid-semester test is now worth 10% (in 2019 was 15%) and the final exam is now worth 40% (in 2019 was 35%).