



# **GEOS920**

## **Petroleum Geochemistry**

S2 Day 2016

*Dept of Earth and Planetary Sciences*

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## General Information

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Credit points

4

Prerequisites

Admission to MGeoSc and GEOS309

Corequisites

Co-badged status

### Unit description

This unit will provide coursework masters students with the foundations of petroleum geochemistry, an essential skill for many jobs in the oil and gas industries. You will learn how to go about analysing the chemical composition of sedimentary rocks and fluids such as oils and gases, and especially the organic constituents. This unit will showcase organic geochemical techniques and will be strongly practically based. It will cover the following topics:(1) samples and preparation,(2) microscopy and microprobe,(3) bulk/solids analysis, including elemental analysis, total organic carbon and pyrolysis techniques such as Rock-Eval, MSSV and laser microprobe,(4) spectroscopic methods such as NMR, Raman and FTIR, (5) solvent extraction of rocks and fractionation of total extracts and oils, (6) gas chromatography-mass spectrometry, including MS-MS and GCxGC, (7) Time-of-Flight-Secondary Ion Mass spectrometry, (8) stable C, H, N, O and S isotopes of sedimentary rocks and fluids such as oils and gases, (9) correlation of oils with their potential source rocks and other oils. Experience will be gained in the manipulation and interpretation of data generated by these techniques. The students will learn about the application of these techniques to understanding petroleum systems, and also to deconvoluting the Precambrian biosphere.

## 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:

An advanced knowledge of the principles and concepts of biogeochemistry, basic modelling and element cycles

The ability to select and critically evaluate appropriate proxies to obtain information on past environments

A knowledge of oceanic anoxic events, and the impact of life on element cycles, with a focus on the Cretaceous and Neoproterozoic

An advanced knowledge of the principles and concepts of organic geochemistry

Demonstrated ability to communicate about biogeochemistry and paleo-environments to a wider audience through masters level writing and oral presentation

## Assessment Tasks

Name	Weighting	Due
<a href="#">Tutorial summaries/questions</a>	20%	2nd-16th August 2016
<a href="#">Assignment 1</a>	30%	13th September 2016

Name	Weighting	Due
<a href="#">Assignment 2</a>	30%	25th October 2016
<a href="#">Oral presentation</a>	20%	8th November 2016

## Tutorial summaries/questions

Due: **2nd-16th August 2016**

Weighting: **20%**

Tutorial summaries/questions: in weeks 1, 2 and 3, there will be 3 x 15 minute "last 15 tests", to be completed before leaving the room. Week 1, 5%. Week 2, 2 x 5%. Week 3, 5%.

On successful completion you will be able to:

- An advanced knowledge of the principles and concepts of biogeochemistry, basic modelling and element cycles
- The ability to select and critically evaluate appropriate proxies to obtain information on past environments

## Assignment 1

Due: **13th September 2016**

Weighting: **30%**

Assignment 1: Understanding oceanic anoxic events and snowball earth events using multiple proxies

On successful completion you will be able to:

- An advanced knowledge of the principles and concepts of biogeochemistry, basic modelling and element cycles
- The ability to select and critically evaluate appropriate proxies to obtain information on past environments
- A knowledge of oceanic anoxic events, and the impact of life on element cycles, with a focus on the Cretaceous and Neoproterozoic
- Demonstrated ability to communicate about biogeochemistry and paleo-environments to a wider audience through masters level writing and oral presentation

## Assignment 2

Due: **25th October 2016**

Weighting: **30%**

Assignment 2: Organic petrology and vitrinite reflectance suppression

On successful completion you will be able to:

- An advanced knowledge of the principles and concepts of biogeochemistry, basic modelling and element cycles
- An advanced knowledge of the principles and concepts of organic geochemistry
- Demonstrated ability to communicate about biogeochemistry and paleo-environments to a wider audience through masters level writing and oral presentation

## Oral presentation

Due: **8th November 2016**

Weighting: **20%**

Oral Presentations by everyone in the class on individually allocated topics

On successful completion you will be able to:

- An advanced knowledge of the principles and concepts of biogeochemistry, basic modelling and element cycles
- The ability to select and critically evaluate appropriate proxies to obtain information on past environments
- A knowledge of oceanic anoxic events, and the impact of life on element cycles, with a focus on the Cretaceous and Neoproterozoic
- An advanced knowledge of the principles and concepts of organic geochemistry
- Demonstrated ability to communicate about biogeochemistry and paleo-environments to a wider audience through masters level writing and oral presentation

## Delivery and Resources

### GEOS920 Palaeoenvironments and biogeochemistry (session 2, 2016)

This unit will provide masters students with the foundations of palaeoenvironmental analysis as applied to some key geoscience problems. The unit will have a problem-based approach and will focus on understanding important processes, especially with examples from the Neoproterozoic, Cretaceous and the modern day. Fundamentals of ocean circulation, nutrient supply and the carbon cycle will be introduced. The veracity of biogeochemical oceanographic signals will be assessed, especially with respect to diagenetic overprinting. Box models will be introduced as a means for understanding geochemical and isotopic signals. The unit will cover co-evolution of life and its environment, the effect of bioturbation on sediments, especially across the Precambrian-Cambrian boundary, and the geochemical record of life as expressed through biomarkers. The pros and cons of various proxies used for the reconstruction of palaeotemperatures will be assessed. The unit will build knowledge about important techniques and methods such as stable and radiogenic isotopes, organic geochemistry and microscopic techniques for assessing sediments and sedimentary rocks. Assignments will be designed to build skills in practical and

industry applications of this area, including in the energy industry.

This unit is co-taught with GEOS710 Records of palaeoenvironments: life and geochemistry (Master of Research). The lectures are the same, but the assignments differ slightly due to different learning outcomes. There is only one iLearn site for both units.

### Web pages and electronic resources

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

iLearn is Macquarie's learning management system. Assignments, hand-outs, and reading material will be available here.

**Classes:** There will be 13 compulsory lectures/tutorials to introduce the unit and give you a grounding in the theory behind some of the techniques. It is important that you attend these sessions every week, as they include discussion sections, and also problem solving on hard copy handouts. The sessions will be audio recorded, and will be available direct from the iLearn site for your later review and revision. These classes will be in **W5C 302**, Tuesday 3-5 pm.

## Unit Schedule

GEOS710 Records of Paleoenvironments: Life & Geochemistry					
Week	Dates	What	Who	Classroom: W5C 302	"Last 15"
				Tuesday 3-5 pm	
1	02-Aug-16	Intro	MK/ AA	Snowball Earth from the sediment record: processes & Earth systems	Daisy World
2	09-Aug-16			Physical processes: circulation of the atmosphere and oceans	Given a scenario..
3	16-Aug-16	Radiogenic Isotopes and Box Models		Chemical processes: elemental cycling, nutrients, and using box models	Jolly's age of ocean
4	23-Aug-16		AA	Nd isotopes in the Cretaceous... what else do we need to know	
5	30-Aug-16	Stable Isotopes	MK	Neoproterozoic & Cretaceous OAES, perturbations of C cycle	
6	06-Sep-16			Stable isotopes, veracity of signals regarding diagenesis	
7	13-Sep-16	Catch up		as needed	
Break	20-Sep-16				
Break	27-Sep-16				
8	04-Oct-16	Life & Biogeochemistry	SL	OAES continued, changes in carbonate compensation	
9	11-Oct-16			Bioturbation across Neoprot-Cambrian, impact of life on cycles	

10	18-Oct-16	Organic Geochemistry & Biomarkers	SG	Intro to organics; inference of paleoenvironments; age-related biomarkers; thermal maturity	
11	25-Oct-16			Chemical record of life; microorganisms and geological deposits; deep biosphere	
12	01-Nov-16			Paleotemperatures: alkenones & TEX86; environmental/oil spills	
13	08-Nov-16	Wrap up	all	Student Presentations	

## Policies and Procedures

Macquarie University policies and procedures are accessible from [Policy Central](#). Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy [http://mq.edu.au/policy/docs/academic\\_honesty/policy.html](http://mq.edu.au/policy/docs/academic_honesty/policy.html)

**New Assessment Policy in effect from Session 2 2016** [http://mq.edu.au/policy/docs/assessment/policy\\_2016.html](http://mq.edu.au/policy/docs/assessment/policy_2016.html). For more information visit [http://students.mq.edu.au/events/2016/07/19/new\\_assessment\\_policy\\_in\\_place\\_from\\_session\\_2/](http://students.mq.edu.au/events/2016/07/19/new_assessment_policy_in_place_from_session_2/)

Assessment Policy prior to Session 2 2016 <http://mq.edu.au/policy/docs/assessment/policy.html>

Grading Policy prior to Session 2 2016 <http://mq.edu.au/policy/docs/grading/policy.html>

Grade Appeal Policy <http://mq.edu.au/policy/docs/gradeappeal/policy.html>

Complaint Management Procedure for Students and Members of the Public [http://www.mq.edu.au/policy/docs/complaint\\_management/procedure.html](http://www.mq.edu.au/policy/docs/complaint_management/procedure.html)

Disruption to Studies Policy [http://www.mq.edu.au/policy/docs/disruption\\_studies/policy.html](http://www.mq.edu.au/policy/docs/disruption_studies/policy.html) *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the [Learning and Teaching Category](#) of 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/support/student\\_conduct/](https://students.mq.edu.au/support/student_conduct/)

## Results

Results shown in *iLearn*, 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](http://ask.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](http://mq.edu.au/learningskills)) provides academic writing resources and study strategies to improve your marks and take control of your study.

- [Workshops](#)
- [StudyWise](#)
- [Academic Integrity Module for Students](#)
- [Ask a Learning Adviser](#)

## 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](http://ask.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/](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.

## Graduate Capabilities

### PG - Capable of Professional and Personal Judgment and Initiative

Our postgraduates will demonstrate a high standard of discernment and common sense in their professional and personal judgment. They will have the ability to make informed choices and decisions that reflect both the nature of their professional work and their personal perspectives.

This graduate capability is supported by:

### Learning outcomes

- The ability to select and critically evaluate appropriate proxies to obtain information on past environments
- A knowledge of oceanic anoxic events, and the impact of life on element cycles, with a focus on the Cretaceous and Neoproterozoic
- An advanced knowledge of the principles and concepts of organic geochemistry
- Demonstrated ability to communicate about biogeochemistry and paleo-environments to a wider audience through masters level writing and oral presentation



## Assessment tasks

- Tutorial summaries/questions
- Assignment 1
- Assignment 2
- Oral presentation

## PG - Discipline Knowledge and Skills

Our postgraduates will be able to demonstrate a significantly enhanced depth and breadth of knowledge, scholarly understanding, and specific subject content knowledge in their chosen fields.

This graduate capability is supported by:

## Learning outcomes

- An advanced knowledge of the principles and concepts of biogeochemistry, basic modelling and element cycles
- The ability to select and critically evaluate appropriate proxies to obtain information on past environments
- A knowledge of oceanic anoxic events, and the impact of life on element cycles, with a focus on the Cretaceous and Neoproterozoic
- An advanced knowledge of the principles and concepts of organic geochemistry
- Demonstrated ability to communicate about biogeochemistry and paleo-environments to a wider audience through masters level writing and oral presentation

## Assessment tasks

- Tutorial summaries/questions
- Assignment 1
- Assignment 2
- Oral presentation

## PG - Critical, Analytical and Integrative Thinking

Our postgraduates will be capable of utilising and reflecting on prior knowledge and experience, of applying higher level critical thinking skills, and of integrating and synthesising learning and knowledge from a range of sources and environments. A characteristic of this form of thinking is the generation of new, professionally oriented knowledge through personal or group-based critique of practice and theory.

This graduate capability is supported by:

## Learning outcomes

- An advanced knowledge of the principles and concepts of biogeochemistry, basic modelling and element cycles
- The ability to select and critically evaluate appropriate proxies to obtain information on past environments
- A knowledge of oceanic anoxic events, and the impact of life on element cycles, with a focus on the Cretaceous and Neoproterozoic
- An advanced knowledge of the principles and concepts of organic geochemistry

## Assessment tasks

- Tutorial summaries/questions
- Assignment 1
- Assignment 2
- Oral presentation

## PG - Research and Problem Solving Capability

Our postgraduates will be capable of systematic enquiry; able to use research skills to create new knowledge that can be applied to real world issues, or contribute to a field of study or practice to enhance society. They will be capable of creative questioning, problem finding and problem solving.

This graduate capability is supported by:

## Learning outcomes

- The ability to select and critically evaluate appropriate proxies to obtain information on past environments
- A knowledge of oceanic anoxic events, and the impact of life on element cycles, with a focus on the Cretaceous and Neoproterozoic
- An advanced knowledge of the principles and concepts of organic geochemistry

## Assessment tasks

- Tutorial summaries/questions
- Assignment 1
- Assignment 2
- Oral presentation

## PG - Effective Communication

Our postgraduates will be able to communicate effectively and convey their views to different social, cultural, and professional audiences. They will be able to use a variety of technologically

supported media to communicate with empathy using a range of written, spoken or visual formats.

This graduate capability is supported by:

## **Learning outcomes**

- The ability to select and critically evaluate appropriate proxies to obtain information on past environments
- A knowledge of oceanic anoxic events, and the impact of life on element cycles, with a focus on the Cretaceous and Neoproterozoic
- An advanced knowledge of the principles and concepts of organic geochemistry
- Demonstrated ability to communicate about biogeochemistry and paleo-environments to a wider audience through masters level writing and oral presentation

## **Assessment tasks**

- Tutorial summaries/questions
- Assignment 1
- Assignment 2
- Oral presentation

## **PG - Engaged and Responsible, Active and Ethical Citizens**

Our postgraduates will be ethically aware and capable of confident transformative action in relation to their professional responsibilities and the wider community. They will have a sense of connectedness with others and country and have a sense of mutual obligation. They will be able to appreciate the impact of their professional roles for social justice and inclusion related to national and global issues

This graduate capability is supported by:

## **Learning outcome**

- An advanced knowledge of the principles and concepts of biogeochemistry, basic modelling and element cycles

## **Assessment tasks**

- Assignment 1
- Assignment 2
- Oral presentation

## **Changes from Previous Offering**

The unit has been completely restructured since 2015. The practical component has been completely removed (can now be done as part of GEOS807). The breadth of the unit has been much widened from the original organic geochemistry, and involves 3 new teaching staff (April,

Martin, Stefan). There are new assessments, and lectures and tutorials are mostly new in 2016. The class test has been removed.