



# GEOS710

## The Organic Geochemistry of Sedimentary Rocks, Oils and Gases

S2 Day 2015

*Dept of Earth and Planetary Sciences*

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## General Information

Unit convenor and teaching staff

Unit Convenor

Simon George

[simon.george@mq.edu.au](mailto:simon.george@mq.edu.au)

Contact via [simon.george@mq.edu.au](mailto:simon.george@mq.edu.au)

E7A 514

Send email to book time

Credit points

4

Prerequisites

Admission to MRes

Corequisites

Co-badged status

Unit description

This unit provides the foundations for 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: (i) Samples and preparation, (ii) Microscopy and microprobe, (iii) Bulk/solids analysis, including elemental analysis, total organic carbon and pyrolysis techniques such as Rock-Eval, MSSV and laser microprobe, (iv) Spectroscopic methods such as NMR, Raman and FTIR, (v) Solvent extraction of rocks and fractionation of total extracts and oils, (vi) Gas chromatography-mass spectrometry, including MS-MS and GCxGC Time-of-Flight Secondary Ion Mass spectrometry, and (vii) Stable C, H, N, O and S isotopes of sedimentary rocks and fluids such as oils and gases. Experience will also be gained in the manipulation and interpretation of data generated by these techniques. Lastly, these techniques will be applied to understanding petroleum systems and 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 organic geochemistry

The ability to select appropriate techniques to obtain information on the chemical composition of sedimentary rocks and fluids such as oils and gases

Practical experience in carrying out basic organic geochemical procedures and interpreting and synthesising large and complex organic geochemical datasets

Demonstrated ability to communicate the results of practical organic geochemical experiments to a wider audience through masters level writing and oral presentation

A firm basis for applying organic geochemical technology to solving petroleum system problems and to deconvoluting the early biosphere.

The ability to undertake large organic geochemistry research projects at HDR level.

## Assessment Tasks

Name	Weighting	Due
<u>Assignment 1</u>	15%	21st August 2015
<u>Practical work 1</u>	25%	4th September 2015
<u>Assignment 2</u>	15%	2nd October 2015
<u>Practical work 2</u>	25%	20th November 2015
<u>Class test</u>	20%	4th November 2015

### Assignment 1

Due: **21st August 2015**

Weighting: **15%**

Assignment 1: Organic petrology and vitrinite reflectance suppression, focus on research aspects

On successful completion you will be able to:

- An advanced knowledge of the principles and concepts of organic geochemistry
- The ability to select appropriate techniques to obtain information on the chemical composition of sedimentary rocks and fluids such as oils and gases
- A firm basis for applying organic geochemical technology to solving petroleum system problems and to deconvoluting the early biosphere.
- The ability to undertake large organic geochemistry research projects at HDR level.

## Practical work 1

Due: **4th September 2015**

Weighting: **25%**

Practical work 1: North Sea Oil fractionation, GC-MS and interpretation

On successful completion you will be able to:

- An advanced knowledge of the principles and concepts of organic geochemistry
- The ability to select appropriate techniques to obtain information on the chemical composition of sedimentary rocks and fluids such as oils and gases
- Practical experience in carrying out basic organic geochemical procedures and interpreting and synthesising large and complex organic geochemical datasets
- Demonstrated ability to communicate the results of practical organic geochemical experiments to a wider audience through masters level writing and oral presentation
- A firm basis for applying organic geochemical technology to solving petroleum system problems and to deconvoluting the early biosphere.
- The ability to undertake large organic geochemistry research projects at HDR level.

## Assignment 2

Due: **2nd October 2015**

Weighting: **15%**

Assignment 2: Carbon, hydrogen and sulphur isotopic compositions, focus on research aspects

On successful completion you will be able to:

- An advanced knowledge of the principles and concepts of organic geochemistry
- The ability to select appropriate techniques to obtain information on the chemical composition of sedimentary rocks and fluids such as oils and gases
- A firm basis for applying organic geochemical technology to solving petroleum system problems and to deconvoluting the early biosphere.
- The ability to undertake large organic geochemistry research projects at HDR level.

## Practical work 2

Due: **20th November 2015**

Weighting: **25%**

Practical work 2: Extraction of sedimentary rocks, GC-MS and oil-source correlation

On successful completion you will be able to:

- An advanced knowledge of the principles and concepts of organic geochemistry
- The ability to select appropriate techniques to obtain information on the chemical composition of sedimentary rocks and fluids such as oils and gases
- Practical experience in carrying out basic organic geochemical procedures and interpreting and synthesising large and complex organic geochemical datasets
- Demonstrated ability to communicate the results of practical organic geochemical experiments to a wider audience through masters level writing and oral presentation
- A firm basis for applying organic geochemical technology to solving petroleum system problems and to deconvoluting the early biosphere.
- The ability to undertake large organic geochemistry research projects at HDR level.

## Class test

Due: **4th November 2015**

Weighting: **20%**

GEOS710 Class test on lecture material

On successful completion you will be able to:

- An advanced knowledge of the principles and concepts of organic geochemistry
- The ability to select appropriate techniques to obtain information on the chemical composition of sedimentary rocks and fluids such as oils and gases
- A firm basis for applying organic geochemical technology to solving petroleum system problems and to deconvoluting the early biosphere.
- The ability to undertake large organic geochemistry research projects at HDR level.

## Delivery and Resources

### **GEOS710: The Organic Geochemistry of Source Rocks, Oils and Gases (Session 2, 2015)**

This unit provides the foundations on 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 fill the gap between the mainly theoretical broad geochemistry unit (GEOS711: Ages and Processes: Advanced Geochemistry; Special Topics in Geochemistry 2) and the mainly inorganic analysis techniques based unit (GEOS776: Advanced Geochemical Applications). 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 micropyrolysis. (4) Solvent extraction of rocks and fractionation of totals extracts and oils. (5) Gas chromatography-mass spectrometry, including MS-MS and GCxGC. (6) Time-of-Flight-Secondary Ion Mass spectrometry. (7) Stable C, H, N, O and S isotopes of sedimentary rocks and fluids such as oils and gases. Experience will also be gained in the manipulation and interpretation of data generated by these techniques. Lastly,

these techniques will be applied to understanding petroleum systems and to deconvolution of the early biosphere.

Undergraduates with a major in geology will likely have a basic understanding of organic geochemistry and no practical skills in this subject. Similarly, undergraduates with a major in chemistry will likely have a good understanding of analytical and organic chemistry, and some lab skills, but may not have a depth in understanding of how these skills can be applied to geological samples. This unit allows a Masters of Research student who has limited hand-on research experience to gain an advanced understanding of organic geochemistry, and to develop their practical skills in an organic geochemistry laboratory. They will start to appreciate the wide scope of the literature in this area, and will develop skills related to the manipulation of raw data and the interpretation of large and complex datasets. Two practical applications of these techniques will be presented which are topical to both industry and further research.

This unit is co-taught with GEOS920 Petroleum Geochemistry (Master of Geoscience). The lectures and practicals are the same, but the assignments differ slightly due to different learning outcomes. There is only one iLearn site for both units.

## **Contacts and Communication**

### **Convenor: Professor Simon George**

simon.george@mq.edu.au      02 9850 4424

Department of Earth and Planetary Sciences (EPS), Room 2.674, 2nd Floor, The Australian Hearing Hub (AHH), 16 University Avenue, Macquarie University.

Other contact details: Lab is E7B 340. Lab phones are 02 9850 8273/8274. Mobile: 0418 428217

<http://web.science.mq.edu.au/directory/listing/person.htm?id=sgeorge>

EPS Admin (if Simon George is not available): Room 2.685 AHH, phone 02 9850 8426/8373

## **Readings and Textbook**

- Peters et al. 2005, The Biomarker Guide. 2 volumes, multiple copies in library (TN271.P4 P463), and there are also two Organic Geochemistry lab copies of each volume.
- Also Vol 2 is available through library as e-book:

(Search Biomarker Guide on MU Library site, and click on “Electronic version available via EBL”)

## **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**

### **Lectures**

There will be 10 lectures to introduce the unit and give you a grounding in the theory behind some of the techniques. It is important that you attend these lectures every week, as they include discussion sections, and also problem solving on hard copy handouts. The lectures will be recorded, and will be available direct from the iLearn site for your later review and revision. Lectures will be in EMC-G230 Faculty Tute Rm, Wednesdays 14:00-16:00 (they will go for > 1 hour, so the room is booked until 16:00, although none will go the whole 2 hours).

### **Practicals**

The majority of the unit will be (1) practical material taught in the Organic Geochemistry lab at Macquarie University (E7B340/344) by Simon George, perhaps with assistance from other research students at times, and (2) independent research, reading, and writing of reports and assignments.

The practicals will be in the Organic Geochemistry Laboratory, E7B340/344 on either Tuesday, Thursday or Friday, and I will contact you before semester to confirm which day I have allocated you to. You may well spend more time in the lab in some weeks than others (block mode), and this may be partly driven by access to fume cupboards and instruments. The weeks when I would like to concentrate supervised lab effort are:

Weeks 2 and 3, 4-7<sup>th</sup> August, and 11-14<sup>th</sup> August

Weeks 9 to 11, 6-9<sup>th</sup> October, 13-16<sup>th</sup> October, and 20-23<sup>rd</sup> October

In other weeks, you will need to work on processing analytical data from the samples (in the lab), and writing up the experiments (in your own time). This will have to be coordinated between everyone doing the unit, as there are only 2 PCs for GC-MS data processing (USB key locked).

In the first week, we will concentrate on:

1. Familiarisation with the lab and lab induction (including access arrangements via swipe card (your CDX number on student card will be needed by Ron Claassens for profiling for access to E7B 340/344; [ron.claassens@mq.edu.au](mailto:ron.claassens@mq.edu.au))
2. Reading material safety data sheets (MSDS)
3. Completing risk assessments.
4. Each of you will need to have a chemical safety induction (if not done already). If possible do this in small groups. Please contact Jenny ([jenny.minard@mq.edu.au](mailto:jenny.minard@mq.edu.au); 02-9850-8169) to arrange the time for this (and state that you are masters students working in Simon George's lab, she knows to expect you). C5C Level 4 (W entrance), ask at reception. She often has groups on Friday at 11am.

## 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)

Assessment Policy <http://mq.edu.au/policy/docs/assessment/policy.html>

Grading Policy <http://mq.edu.au/policy/docs/grading/policy.html>

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

Grievance Management Policy [http://mq.edu.au/policy/docs/grievance\\_management/policy.html](http://mq.edu.au/policy/docs/grievance_management/policy.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://stu>



[dents.mq.edu.au/support/](https://unitguides.mq.edu.au/support/)

## Learning Skills

Learning Skills ([mq.edu.au/learningskills](https://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](https://ask.mq.edu.au)

## IT Help

For help with University computer systems and technology, visit <http://informatics.mq.edu.au/help/>.

When using the University's IT, you must adhere to the [Acceptable Use 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 appropriate techniques to obtain information on the chemical composition of sedimentary rocks and fluids such as oils and gases
- Practical experience in carrying out basic organic geochemical procedures and interpreting and synthesising large and complex organic geochemical datasets
- Demonstrated ability to communicate the results of practical organic geochemical experiments to a wider audience through masters level writing and oral presentation
- A firm basis for applying organic geochemical technology to solving petroleum system

problems and to deconvoluting the early biosphere.

- The ability to undertake large organic geochemistry research projects at HDR level.

## **Assessment tasks**

- Assignment 1
- Practical work 1
- Assignment 2
- Practical work 2
- Class test

## **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 organic geochemistry
- The ability to select appropriate techniques to obtain information on the chemical composition of sedimentary rocks and fluids such as oils and gases
- Practical experience in carrying out basic organic geochemical procedures and interpreting and synthesising large and complex organic geochemical datasets
- Demonstrated ability to communicate the results of practical organic geochemical experiments to a wider audience through masters level writing and oral presentation
- A firm basis for applying organic geochemical technology to solving petroleum system problems and to deconvoluting the early biosphere.
- The ability to undertake large organic geochemistry research projects at HDR level.

## **Assessment tasks**

- Assignment 1
- Practical work 1
- Assignment 2
- Practical work 2
- Class test

## **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 organic geochemistry
- The ability to select appropriate techniques to obtain information on the chemical composition of sedimentary rocks and fluids such as oils and gases
- Practical experience in carrying out basic organic geochemical procedures and interpreting and synthesising large and complex organic geochemical datasets
- A firm basis for applying organic geochemical technology to solving petroleum system problems and to deconvoluting the early biosphere.
- The ability to undertake large organic geochemistry research projects at HDR level.

## **Assessment tasks**

- Assignment 1
- Practical work 1
- Assignment 2
- Practical work 2
- Class test

## **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 appropriate techniques to obtain information on the chemical composition of sedimentary rocks and fluids such as oils and gases
- Practical experience in carrying out basic organic geochemical procedures and interpreting and synthesising large and complex organic geochemical datasets
- A firm basis for applying organic geochemical technology to solving petroleum system problems and to deconvoluting the early biosphere.
- The ability to undertake large organic geochemistry research projects at HDR level.

## Assessment tasks

- Assignment 1
- Practical work 1
- Assignment 2
- Practical work 2
- Class test

## 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 appropriate techniques to obtain information on the chemical composition of sedimentary rocks and fluids such as oils and gases
- Practical experience in carrying out basic organic geochemical procedures and interpreting and synthesising large and complex organic geochemical datasets
- Demonstrated ability to communicate the results of practical organic geochemical experiments to a wider audience through masters level writing and oral presentation
- A firm basis for applying organic geochemical technology to solving petroleum system problems and to deconvoluting the early biosphere.

## Assessment tasks

- Assignment 1
- Practical work 1
- Assignment 2
- Practical work 2
- Class test

## 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 organic geochemistry

## **Assessment tasks**

- Assignment 1
- Practical work 1
- Assignment 2
- Practical work 2

## **Changes from Previous Offering**

A class test has been added based on LEU feedback in 2014, and the % marks for the other assessed components correspondingly increased. Lectures have been rearranged, and an extra one on “Interpretation of biomarkers and hydrocarbons in oils and rocks” has been added based on LEU feedback in 2014.