



GEOS710

The Organic Geochemistry of Sedimentary Rocks, Oils and Gases

S2 Day 2014

Earth and Planetary Sciences

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General Information

Unit convenor and teaching staff

Unit Convenor

Simon George

simon.george@mq.edu.au

Contact via 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:- Samples and preparation- Microscopy and microprobe- Bulk/solids analysis, including elemental analysis, total organic carbon and pyrolysis techniques such as Rock-Eval, MSSV and laser microprobe- Spectroscopic methods such as NMR, Raman and FTIR- Solvent extraction of rocks and fractionation of total extracts and oils- Gas chromatography-mass spectrometry, including MS-MS and GCxGC- Time-of-Flight- Secondary Ion Mass spectrometry- 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.

Assessment Tasks

Name	Weighting	Due
Assignment 1	20%	25th August 2014
Practical work 1	30%	15th September 2014
Assignment 2	20%	13th October 2014
Practical work 2	30%	14th November 2014

Assignment 1

Due: **25th August 2014**

Weighting: **20%**

Assignment 1: Organic petrology and vitrinite reflectance suppression

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.

Practical work 1

Due: **15th September 2014**

Weighting: **30%**

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.

Assignment 2

Due: **13th October 2014**

Weighting: **20%**

Assignment 2: Carbon, hydrogen and sulphur isotopic compositions

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.

Practical work 2

Due: **14th November 2014**

Weighting: **30%**

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.

Delivery and Resources

GEOS710, Special Topics in Geochemistry 1: Organic Geochemistry- Source Rocks, Oils & Gases (Session 2, 2014)

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.

Classes and contact hours:

There will be 9 official lectures in the first half of the session, to introduce the unit and give you a grounding in the theory behind some of the techniques. These are recorded and will be available direct from Simon and the iLearn site for your review. However, 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.

Hours

This is a 4 credit point unit. It is anticipated that you will spend ~12 hours per week involved with the unit, over the 15 weeks of session (total 180 hours).

Contacts and Communication

Convenor: Professor Simon George

simon.george@mq.edu.au

02 9850 4424 Office: E7A 514

Department of Earth and Planetary Sciences (EPS), Macquarie University.

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

<http://eps.mq.edu.au/staff/SimonGeorge/SimonGeorge.htm>

EPS Admin (if Simon George is not available): E7A 507, phone 02 9850 8426 or 02 9850 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 is 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.

Unit Schedule

Lectures

The lecture slides will be available through iLearn, and the audio will also be recorded and made available.

Lectures will be in E7A 829 Faculty Tute Rm on Mondays, from 14:00 (they may go for > 1 hour, so the room is booked until 16:00, although none will go the whole 2 hours). There are 9 lectures, over the first 10 weeks of semester (no lecture on Mon 6th October, Labor Day).

Practicals

The rest of the face-to face activity will be practicals that happen in the Organic Geochemistry Laboratory, E7B340/344. This will happen on Tuesdays and Wednesdays, and I will contact you before semester to confirm which day I have you allocated 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, 12-13th August, and 19-20th August

Weeks 8 to 10, 7-8th October, 14-15th October, and 20-21st 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)
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; 02-9850-8169) to arrange the time for this (and state that you are doing masters research 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.

Unit schedule and due dates for practical and assignments

Topics and dates of lectures:

Week 1, Mon 4th August 2014.

Lecture 1, GEOS710 introduction; Introduction to biogeochemistry

What is biogeochemistry? High level stuff. Origin and preservation of organic matter. Organic chemistry included here. Carbon cycle.

Week 2, Mon 11th August 2014.

Lecture 2, Organic geochemical methods

Extraction, fractionation, GC-MS. Everything you need to know to analyse biomarkers.

Week 3, Mon 18th August 2014.

Lecture 3, Biomarkers in rocks and oil

The basic stuff and relationships. Oil formation. Fluid inclusions. Precambrian biomarkers. John Volkman sterol review paper.

Week 4, Mon 25th August 2014.

Lecture 4, How microorganisms affect geological deposits and vice versa

Biodegradation and the deep biosphere.

Week 5, Mon 1st September 2014.

Lecture 5, Interface of proteomics, molecular biology and organic geochemistry

Highlight how interpretation of biomarkers is being informed by culturing. Phylogeny of hopanoid producers using culture-independent methods.

Week 6, Mon 8th September 2014.

Lecture 6, Marine biogeochemistry: Palaeothermometers

Alkenone-sea surface temperature (SST) record (palaeothermometer) Uk37.

The TEX86 paleothermometer

Week 7 Mon 15th September 2014.

Lecture 7, The chemical record of life on earth

Evolution of diatoms and HBIs; Angiosperms and oleanane; Dinoflagellates and dinosteroids; Stromatoporids and isopropylcholestanes; Precambrian geochemistry / the Moon

Week 9, Mon 13th October 2014.

Lecture 8, Biomarkers in present-day environments, and wrap-up

Oil spills, Exxon Valdez. Urban aerosols. Toxicity, monitoring. MEOR and CO₂ sequestration.

Week 10, Mon 20th October 2014.

Lecture 9, How to do oil-source correlations

Not taped, new lecture, will be given live.

Dates of Assessed work:

Assignment 1: Organic petrology and vitrinite reflectance suppression.

Released week 1, 4th August 2014. Due week 4, 25th August 2014, 17:00

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

Released week 1, 4th August 2014. Due week 7, 15th September 2014, 17:00

Assignment 2: Carbon, hydrogen and sulphur isotopic compositions

Released week 7, 15th September 2014. Due week 9, 13th October 2014 17:00

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

Released week 8, 7th October 2014. Due week 13, 14th November 2014, 17:00

This practical assessment will also involve an oral presentation on part of the prac on the Tues or Wed in week 13 to the whole class.

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

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

Disruption to Studies Policy 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/

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 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

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 - 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.

Assessment tasks

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

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.

Assessment tasks

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

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.

Assessment tasks

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

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

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

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.

Assessment tasks

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

Changes from Previous Offering

The number of practical assessments has been reduced from 3 to 2, and % marks for the other assessed components correspondingly increased, so as to reduced student workload, based on feedback from the 2013 cohort.

Changes since First Published

Date	Description
28/02/2014	The Description was updated.