



GEOS309

Marine Sediments and Energy Resources

S2 Day 2017

Dept of Earth and Planetary Sciences

Contents

<u>General Information</u>	2
<u>Learning Outcomes</u>	3
<u>General Assessment Information</u>	3
<u>Assessment Tasks</u>	4
<u>Delivery and Resources</u>	6
<u>Unit Schedule</u>	12
<u>Policies and Procedures</u>	12
<u>Graduate Capabilities</u>	13
<u>Changes from Previous Offering</u>	18

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.

General Information

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Credit points

3

Prerequisites

GEOS206 and GEOS226

Corequisites

Co-badged status

Unit description

This unit focuses on developing an advanced level of understanding of sedimentary rocks, oil and gas. The latter are major components of Australia's energy supply, but have significant negative impacts on our environment. To understand the balance between fossil fuel exploitation and negative environmental impacts, it is important to learn about how oil and gas are formed, how they are discovered and recovered, and how they can be utilised in less environmentally harmful ways. This unit combines geological and geochemical approaches to investigate the basinal formation of sediments, and exploration and production methods for crude oil, natural gas, coal bed methane and shale gas. The key components of conventional and unconventional petroleum systems are considered, from source rock formation through generation, expulsion, migration, accumulation and alteration in reservoirs, as are mechanisms for oil and gas production from conventional and unconventional reservoirs. Geothermal energy is also assessed. Similar technologies are also utilised for the geosequestration of CO₂, and the opportunities for this in Australia are assessed. This unit prepares students for careers in the energy and geosequestration industries.

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:

- Understanding of the tools and methods that are used in the petroleum industry
- Knowledge of conventional and unconventional petroleum system analysis techniques.
- Understanding of marine sediments and sedimentary rocks
- Understanding of some key Earth system cycles
- Competence in accessing, using and synthesising appropriate information through writing
- Application of knowledge to solving problems and evaluating ideas and information

General Assessment Information

On-line quizzes on lectures

After each lecture a quiz will open to make sure you have read and understood the lecture material. The quizzes will be available on-line through the iLearn system (see "Quizzes" section in each module of iLearn) and together are worth 10% of the unit mark. You will do these in your own time, open book, and they will be open until 23:59 on the following Sunday (5 days to do each of them). The question order will be forced and random, there will be a time limit of 30 mins on the lecture quizzes, and you only get one go. In week 8 there is a live lecture (8a), and also a taped lecture from 2016 (8b), and thus there will be two quizzes to complete in that week. There

is no lecture or quiz in week 13. The 10% quiz mark will be derived by summing all 13 of the lecture quizzes and normalising.

Practicals

A very important component of GEOS309 are the practicals. These are for 3 hours, 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, it will be a more tutorial format, with group work and discussion; for example, the coal-bed methane short course, and peak oil discussion. Other weeks they will be more practically and hands-on oriented. Some weeks you will be working on computers, other times on microscopes or virtual microscopes, or hard copy work sheets. The petroleum system practical will be assessed using a submitted written text, this will be submitted using turnitin. You will be given specific details of what is expected for the practical assessment when you begin each section of the class. Please bring pencils, pens, coloured pencils and a ruler to the practicals.

Assignments

You will be given specific details of what is expected for the two assignments when you begin each section of the class. Generally, the assignments will involve a written 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 on the date shown, and on the date shown will be discussed during the practicals.

The two assignments are essay based, so skill at writing essays is important. Each assignment topic must be fully researched and the essay written in your own words. Cutting and pasting information from web pages is NOT acceptable. Information you do 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 assignments. All assignments are to be typed, and will be submitted for turnitin checking and grademark assessment through iLearn. You will not need to produce hard copy of these two assignments. The assignments will be due on Mondays at 9am.

Assessment Tasks

Name	Weighting	Hurdle	Due
<u>Assignment 1</u>	15%	No	Monday 21st August, 9am
<u>Practical work 1</u>	10%	No	Monday 4th September, 9am
<u>Assignment 2</u>	15%	No	Monday 16th October, 9am

Name	Weighting	Hurdle	Due
On-line iLearn quizzes	10%	No	Throughout semester
Unit exam	50%	No	Exam period

Assignment 1

Due: **Monday 21st August, 9am**

Weighting: **15%**

Assignment 1: Literature review on oil biodegradation

On successful completion you will be able to:

- Understanding of the tools and methods that are used in the petroleum industry
- Knowledge of conventional and unconventional petroleum system analysis techniques.
- Competence in accessing, using and synthesising appropriate information through writing
- Application of knowledge to solving problems and evaluating ideas and information

Practical work 1

Due: **Monday 4th September, 9am**

Weighting: **10%**

Practical work: The Petroleum System

On successful completion you will be able to:

- Understanding of the tools and methods that are used in the petroleum industry
- Knowledge of conventional and unconventional petroleum system analysis techniques.
- Understanding of marine sediments and sedimentary rocks
- Competence in accessing, using and synthesising appropriate information through writing
- Application of knowledge to solving problems and evaluating ideas and information

Assignment 2

Due: **Monday 16th October, 9am**

Weighting: **15%**

Assignment 2: Essay on an unconventional energy topic

On successful completion you will be able to:

- Understanding of the tools and methods that are used in the petroleum industry

- Knowledge of conventional and unconventional petroleum system analysis techniques.
- Competence in accessing, using and synthesising appropriate information through writing

On-line iLearn quizzes

Due: **Throughout semester**

Weighting: **10%**

On-line iLearn quizzes on lectures, throughout semester

On successful completion you will be able to:

- Understanding of the tools and methods that are used in the petroleum industry
- Knowledge of conventional and unconventional petroleum system analysis techniques.
- Understanding of marine sediments and sedimentary rocks
- Understanding of some key Earth system cycles

Unit exam

Due: **Exam period**

Weighting: **50%**

Unit exam

On successful completion you will be able to:

- Understanding of the tools and methods that are used in the petroleum industry
- Knowledge of conventional and unconventional petroleum system analysis techniques.
- Understanding of marine sediments and sedimentary rocks
- Understanding of some key Earth system cycles
- Application of knowledge to solving problems and evaluating ideas and information

Delivery and Resources

The unit will be presented in 3 broad themes:

Theme 1: The Petroleum system. Conventional oil and gas. Formation of organic-rich rocks, the carbon cycle, thermal maturation, organic geochemistry, oil biodegradation, petroleum generation and expulsion. Coarse grained sedimentary rocks and diagenesis, reservoir rocks. Subsurface fluid movement, seals, migration, timing of charge.

Theme 2: Unconventional energy resources. Coal bed methane (coal seam gas), underground coal gasification, shale gas, shale (tight) oil, oil shales, tar sands, geothermal energy, CO₂ sequestration. Forecasts for oil and gas supply for next 30 years.

Theme 3: Earth System Cycles. This is a new module for this unit in 2017, and reflects a change in content for GEOS309 that will be fully implemented in 2018. This module will focus on

the Earth as a system, including feedback loops and key thresholds, particularly related to the carbon cycle and temperature history.

Classes and contact hours:

Attend the one hour lecture, and the three hour practical each week.

Lecture: 14 Eastern Rd (E8A), 386 Tutorial Rm, Tuesdays 12:00-13:00

Practicals: 11 Wally's Walk (E5A), 210, Tuesdays, 09:00-12:00

It is the policy in this unit that internal students will normally attend the lecture and a practical each week, and will make their own notes from the lectures. It is expected that many of the lectures will be interactive, with questions and answers throughout. 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. Some of the practicals are assessed; it is important that you attend the practicals each week.

This unit can be seen as an interconnected stream between lectures and practicals. We may choose to have a short lecture or video, and sometimes short course format, within the three hour practical. The lecture stream will give a broad overview of the topics, provide background information and introduce new ideas and concepts that link in with the practical stream.

Late Enrolments

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

Hours

This is a 3 credit point unit. It is anticipated that you will spend >9 hours per week involved with the unit, including the four hour class contact time per week, and approximately four to five hours per week doing home study. It is particularly important that you spend plenty of time preparing the two assignments.

GEOS309 prize and PESA

The Petroleum Exploration Society of Australia (PESA) prize for proficiency in the unit GEOS309 Marine Sediments and Energy Resources (value \$500) is awarded annually to the best performing student on GEOS309. Consider joining PESA. It is \$27.50 for students, only ~\$10 for lunchtime talks, there is the possibility of scholarships, and great networking! Simon can sponsor you as a PESA financial member if necessary. <https://www.pesa.com.au/>

Readings and Textbook (free)

- Petroleum Geoscience: From Sedimentary Environments to Rock Physics
- Knut Bjorlykke
- SBN: 978-3-642-02331-6 (Print) 978-3-642-02332-3 (Online)
- <http://link.springer.com/book/10.1007/978-3-642-02332-3/page/1-section=780498&page=1&locus=0>
- This book is free to download as .pdf chapters for Macquarie University students. I strongly advise that you do so in the first week of class. You may have difficulties if you try to do this at home, unless you properly authenticate onto the Mac Uni library site. DO NOT pay money for this book! You can easily download it for free in our library!

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, 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 and will automatically receive email notification of these important announcements. 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 few days.

Sound recordings and pdf files of the lectures: 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 section "GEOS309 lectures" under each Module, 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).

Turnitin Procedure for the two assignments and the petroleum system practical

1. Turnitin links have been placed under Theme 1 for the Practical report, and under Assignments on the iLearn page for GEOS309. There are also links in the "Activities" box on the

right hand side of the iLearn page.

2. For each assignment or practical when it is due, click the corresponding link, then click "Submit Paper".
3. Submission type is preset to file upload for your assignment. You link to a local file for upload (only one file can be uploaded). Select your name, and write or paste in the assignment title.
4. Note: graphics are not checked and can be left in uploaded files. We suggest you keep graphics small, the maximum turnitin upload size is 40 Mb. The reference list is also not checked, so can be left in. When you click to submit, you are declaring that it is your own work (no cover sheet is needed).
5. Resubmissions are set to not be allowed, so please make sure you submit the final version. The system is also set to not display to students the assignment's originality rating.

Grademark is a paperless grading system whereby your assignments will be submitted online and marked by staff online, and feedback will be given online via electronic comments, custom marks and even by voice comments. The staff/tutors marking will be provided with the exact time and date of submission, an overlay of the assignment, and access to the originality checker (via the Turnitin software). Your resulting grades and feedback can be found at the same link in iLearn after the post date.

For help or more detailed instructions on turnitin:

http://turnitin.com/en_us/support/help-center

We will endeavour to return marked assignments and practical to you within 14-21 days of submission. If at any time you have reason to query an assignment mark, please contact Prof. Simon George by phone or email to arrange a meeting.

Illness and Extensions

If you want consideration for illness when submitting any assignments or practicals, you **MUST** submit a Disruption to Studies form online through the link from here:

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

If you want to apply for an extension, you should EMAIL Prof. Simon George **BEFORE THE DUE DATE** of the assignment or practical and state the reason you are seeking an extension. This will not be granted automatically, but will be considered on a case-by-case basis, based on Disruption to Studies or other information. You will be notified by return email as to when you will need to submit your assignment. **LATE PENALTIES** (loss of marks) will apply for work that is late where no extension has been granted: it is a 5% per day penalty for late work (i.e. 1/20 of the marks allocated to the exercise will be deducted for each day that the work is late).

Referencing

It is important that you understand how to correctly reference the information you do use, as often you will want to legitimately quote material or ideas from other sources. Information obtained from any source, including the Internet, is covered by copyright law. You must acknowledge any source that you refer to in your assignment, both within the text of your

assignment, and at the end of it (by including a list of references). Referencing your sources also enables the reader to view your sources and follow your essay. Academic conventions and copyright law require that you acknowledge when you use the ideas of others. In most cases, this means stating which book or journal article is the source of an idea or quotation.

There are two aspects to learn: in-text references and a list of references cited. Please note that for both the GEOS309 assignments, we insist that you reference using in-text references, with a reference list at the end (ie, not with footnotes). This is a common way to do it in many areas of science (but not all!), and it reminds you and indicates to the reader what the source is and how old it is. For GEOS309, please use the Harvard Style of referencing.

There is much information on in-text references and referencing of print and non-print sources available at:

<http://libguides.mq.edu.au/content.php?pid=459099&sid=3778407>

<http://libguides.mq.edu.au/content.php?pid=459099&sid=3759396>

How to cite references within the text of an assignment:

These are also called in-text references. When you use another's ideas you should immediately acknowledge your sources, including in figure or table captions. Always give the surname of the author and the date of publication. Use the author-date method of citation for quotations and paraphrasing. Note spelling of *et al.* (used when 3 or more authors; please remember the fullstop). Note that the in text refs don't have author initials.

Direct quote: Brown *et al.* (1990, p. 12) conclude that 'the depth to the Moho under the oceans is less than under the continents'. Note that for a direct quote the page must be cited.

General acknowledgement of the source of information: "As explained by George and Osborne (2010), biomarkers in fluid inclusions....."

More specific reference but not a direct quote: "The distribution of Martian volcanism in the highlands (Johnson, 2011) can be used to infer... etc."

More general reference to sources: "Most older textbooks in geology (e.g. Peters *et al.*, 1941; Stamp 1938) either ignored the deep ocean basin deposition or....."

Website in text: "Details about PhD scholarships are available from the Macquarie University web site <<http://www.hdr.mq.edu.au/>>."

How to create a list of references:

At the end of your assignment, create a list of the references you have cited in the text. Arrange this in alphabetical order of author's surnames. The author's surname is placed first, followed by initials or first name, then other authors the same way, and then the year of publication is given. Where an item doesn't have an author, arrange it by its title.

Then the reference needs the paper or book title, journal (if it's a journal article), publisher (if it's

a book) or url and date accessed (if it's a web page). The format should follow the Harvard style as described in these links: it is a good guide, and your references should contain the same information.

Please be very careful (a) to put in the reference list every citation from the text (including web sites) and any figure/table captions, and (b) to not put in the list references that you have not cited in the text or figure/table captions.

Reference examples: journal

George, S.C., Volk, H., Dutkiewicz, A., Ridley, J. and Buick, R. (2008) Preservation of hydrocarbons and biomarkers in oil trapped inside fluid inclusions for >2 billion years. *Geochimica Cosmochimica Acta* **72**, 844-870.

George, S.C. (1993) Black sandstones in the Midland Valley of Scotland: thermally metamorphosed hydrocarbon reservoirs? *Transactions of the Royal Society of Edinburgh: Earth Science* **84**, 61-72.

Bourdet, J., Eadington, P., Volk, H., George, S.C., Pironon, J., Kempton, R. (2012) Chemical changes of fluid inclusion oil trapped during the evolution of an oil reservoir: Jabiru-1A case study (Timor Sea, Australia). *Marine and Petroleum Geology* **36**, 118-139.

Ahmed, M. and George, S.C. (2004) Changes in the molecular composition of crude oils during their preparation for GC and GC-MS analyses. *Organic Geochemistry* **35**, 137-155.

Abbassi, S., di Primio, R., Horsfield, B., Volk, H., Edwards, D.S., Anka, Z., George, S.C. (2015) On the filling and leakage of petroleum from traps in the Laminaria High region of the northern Bonaparte Basin, Australia. *Marine and Petroleum Geology* **59**, 91-113.

Reference example: book

Peters, K. E., Walters, C. C. and Moldowan, J. M. (2005) *The Biomarker Guide*, 2nd Edition. Cambridge University Press, Cambridge, 1155 pp.

Reference example: chapters in edited books

George, S.C., Volk, H., Dutkiewicz, A., 2012. Mass spectrometry techniques for analysis of oil and gas trapped in fluid inclusions. In: Lee, M.S. (Ed.), *Handbook of Mass Spectrometry*, Wiley, pp. 647-673.

George, S. C., Volk, H., Ahmed, M., Middleton, H., Allan, T. and Holland, D. (2004) Novel petroleum systems in Papua New Guinea indicated by terpane and methylhopane distributions. In: Boulton, P. J., Johns, D. R. and Lang, S. C. (Eds), *Eastern Australasian Basins Symposium II*, Adelaide, 19-22 September, Petroleum Exploration Society of Australia, Special Publication, pp. 575-588.

Reference example (web site, author and date known):

Wright, S. 2004, *Open area test site (OATS) development*, undergraduate project, University of

Southern Queensland, Toowoomba, viewed 27 March 2011, <<http://eprints.usq.edu.au/archive/00000047>>.

Reference example (web site, author and date not known):

Macquarie University, NSW, viewed 12 January 2012, <<http://www.hdr.mq.edu.au/>>

Unit Schedule

Lectures	Practicals
14 Eastern Rd (E8A), 386 Tutorial Rm, Tuesdays 12:00-13:00	11 Wally's Walk (E5A), 210, Tuesdays, 09:00-12:00

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_2016.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

Disruption to Studies Policy (in effect until Dec 4th, 2017): http://www.mq.edu.au/policy/docs/disruption_studies/policy.html

Special Consideration Policy (in effect from Dec 4th, 2017): <https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policies/special-consideration>

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/

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.

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://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

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be

imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Understanding of the tools and methods that are used in the petroleum industry
- Knowledge of conventional and unconventional petroleum system analysis techniques.
- Understanding of marine sediments and sedimentary rocks
- Understanding of some key Earth system cycles
- Competence in accessing, using and synthesising appropriate information through writing
- Application of knowledge to solving problems and evaluating ideas and information

Assessment tasks

- Assignment 1
- Practical work 1

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

- Understanding of the tools and methods that are used in the petroleum industry
- Knowledge of conventional and unconventional petroleum system analysis techniques.
- Understanding of some key Earth system cycles

Assessment tasks

- Assignment 1
- Assignment 2

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

- Understanding of the tools and methods that are used in the petroleum industry
- Knowledge of conventional and unconventional petroleum system analysis techniques.
- Understanding of some key Earth system cycles
- Competence in accessing, using and synthesising appropriate information through writing

Assessment tasks

- Assignment 1
- Practical work 1
- Assignment 2

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Understanding of the tools and methods that are used in the petroleum industry
- Knowledge of conventional and unconventional petroleum system analysis techniques.
- Understanding of marine sediments and sedimentary rocks
- Understanding of some key Earth system cycles
- Competence in accessing, using and synthesising appropriate information through writing
- Application of knowledge to solving problems and evaluating ideas and information

Assessment tasks

- Assignment 1
- Practical work 1
- Assignment 2
- On-line iLearn quizzes
- Unit exam

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Understanding of the tools and methods that are used in the petroleum industry
- Knowledge of conventional and unconventional petroleum system analysis techniques.
- Understanding of marine sediments and sedimentary rocks
- Understanding of some key Earth system cycles
- Competence in accessing, using and synthesising appropriate information through writing
- Application of knowledge to solving problems and evaluating ideas and information

Assessment tasks

- Assignment 1
- Practical work 1
- Assignment 2
- Unit exam

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Understanding of the tools and methods that are used in the petroleum industry
- Knowledge of conventional and unconventional petroleum system analysis techniques.
- Understanding of marine sediments and sedimentary rocks
- Understanding of some key Earth system cycles
- Application of knowledge to solving problems and evaluating ideas and information

Assessment tasks

- Assignment 1
- Practical work 1
- Assignment 2
- On-line iLearn quizzes
- Unit exam

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- Understanding of the tools and methods that are used in the petroleum industry
- Knowledge of conventional and unconventional petroleum system analysis techniques.
- Understanding of marine sediments and sedimentary rocks
- Understanding of some key Earth system cycles
- Competence in accessing, using and synthesising appropriate information through writing

Assessment tasks

- Assignment 1
- Practical work 1
- Assignment 2

Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

Learning outcomes

- Knowledge of conventional and unconventional petroleum system analysis techniques.

- Understanding of marine sediments and sedimentary rocks
- Understanding of some key Earth system cycles

Assessment task

- Assignment 2

Socially and Environmentally Active and Responsible

We want our graduates to be aware of and have respect for self and others; to be able to work with others as a leader and a team player; to have a sense of connectedness with others and country; and to have a sense of mutual obligation. Our graduates should be informed and active participants in moving society towards sustainability.

This graduate capability is supported by:

Learning outcomes

- Knowledge of conventional and unconventional petroleum system analysis techniques.
- Understanding of marine sediments and sedimentary rocks
- Understanding of some key Earth system cycles

Assessment task

- Assignment 2

Changes from Previous Offering

Changes since the GEOS309 2016 offering

There has been a name change from “Sediments, Liquid Fuels and Energy Security” to “Marine Sediments and Energy Resources”. The lecture and practical order has been changed, and a new third module has been added on Earth System Cycles, replacing older material on basin analysis and sequence stratigraphy.