

MACQUARIE UNIVERSITY  
DEPARTMENT OF EARTH AND PLANETARY SCIENCES

**GEOS316: EXPLORATION GEOPHYSICS**

*2nd SEMESTER 2010*

**UNIT OUTLINE**

**INTRODUCTION**

This unit will deal with the geophysical surveying and data analysis techniques used for exploration of mineral and hydrocarbon resources in both terrestrial and marine environments. The theory, field procedures, interpretation and applications of the major methods in current use will be discussed, with particular reference to Australian exploration conditions. This will include seismic reflection and refraction techniques, gravity and magnetic methods, electrical and electromagnetic methods (including airborne survey techniques), borehole techniques, remote sensing techniques and radiometric surveying. Exercises involving data reduction and interpretation will be used to show the practical aspects of many of the techniques. The field excursion will give experience in the collection of several types of data. The data collected will be reduced and interpreted with the aid of computer programs, and used as the basis for a field report.

**UNIT ORGANISATION AND VENUE**

**Credit Points:** 4

**Prerequisites:** GEOS205 or GEOS268

*Day students:* Classes are held on **Monday, from 12 - 1 pm and then from 2 - 6 pm in Bldg. E5A, Rm. 207.**

The unit also has a WEB site which can be found through the Online Learning @ MQ WEBSITE at <http://learn.mq.edu.au/>. This site contains information such as copies of colour images, copies of overheads and powerpoints shown in class, and copies of the practicals that we do in class. The WEB site will also allow access to the digital version of the lectures recorded through the iLecture system. At the start of the year you should be issued with a username and password to access all the WEB sites available for the units you have taken. This will get you into the front page of the GEOS316 WEB site. Please note that some sections within the WEB site require an internal username and password; the username is **geos316** and please see, or call me to obtain the password. Information for students about access to online units is available at <http://online.mq.edu.au/docs/tecinf.html>.

Dr Mark Lackie is the Unit Convenor for GEOS316 and will teach most of the subjects. As well, invited experts from the geophysical consulting industry will contribute to specific topics.

The Monday noon session will be a lecture, while the Monday after lunch session will be in mixed mode format, involving lecture material, related demonstrations and practical and computer exercises. The majority of practical exercises will involve geophysical data reduction and interpretation, but it is hoped to schedule some laboratory and on-campus field experiments during the semester.

## **Field Excursion**

The five-day (includes one-day travel) field excursion will take place during the mid-semester break and **is scheduled for 29 September - 3 October 2010**. Attendance for the field excursion is compulsory, so you will need to keep these dates clear. During the field trip, geophysical equipment commonly used for mineral exploration surveys is deployed and real data will be collected. An individual comprehensive field report is to be presented by each student, and submitted for assessment. The **due date for submitting the field report is 12 November 2010**. Extensions will only be granted in exceptional circumstances. No work will be accepted after the end of teaching for the semester.

## **KEY LEARNING OUTCOMES**

The key learning outcomes for this unit are:

1. understanding of the basic concepts of exploration geophysics;
2. gaining experience in operating geophysical equipment;
3. understanding scientific methodology;
4. competence in accessing, using and synthesising appropriate information;
5. application of knowledge to solving problems and evaluating ideas and information; and
6. capacity to present ideas clearly with supporting evidence.

## **GRADUATE CAPABILITIES**

Students will enter a globalizing world of major environmental change and resource constraints, of scientific and technological advance and ethical challenge, of continuing political instability and possible international conflicts, of unlimited creativity and increasing social surveillance. To prepare students for life after university, various graduate capabilities are developed through the curriculum. These capabilities are described below.

<b>No.</b>	<b>Capability</b>	<b>Brief Description</b>
1	<i>Discipline Specific Knowledge and Skills</i>	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.
2	<i>Critical, Analytical and Integrative Thinking</i>	Graduates are to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments.
3	<i>Problem Solving and Research Capability</i>	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.
4	<i>Creative and Innovative</i>	Graduates will be capable of creative thinking and of creating knowledge.
5	<i>Effective Communication</i>	Students develop the ability to communicate and convey their views in forms effective with different audiences.
6	<i>Engaged and Ethical Local and Global citizens</i>	Graduates will 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.
7	<i>Socially and Environmentally Active and Responsible</i>	Graduates to be aware of and have respect for self and others.
8	<i>Capable of Professional and Personal Judgement and Initiative</i>	Graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement.
9	<i>Commitment to Continuous Learning</i>	Graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake.

### UNIT ASSESSMENT

The final assessment will consist of four components for both day and external students:

- (1) **Two assignments** will be given to you during the semester. They consist of questions relating to the topics covered in the first 2/3 of the semester and will include questions on both the theoretical and practical aspects of the unit material. The **due dates are 13 September 2010 for Assignment 1, and 25 October 2010 for Assignment 2.**
- (2) Each student has to select a topic relevant to the unit on which a 10-15 minute long **oral presentation** must be given during the class hours. A selection of topics is given at the beginning of the unit.
- (3) A **field report** must be submitted.
- (4) There will be a **final two-hour examination** held during the examination period in November/December. It will consist of a choice of questions to be answered in essay style.

To achieve a passing grade in the unit you must satisfy the following requirements:

- (i) Attendance and satisfactory performance at the field excursion and attendance at the final examination.
- (ii) Give an oral presentation.
- (iii) Submit a field report.
- (iv) Achieve an overall passing grade for the assignments.

The unit will be assessed as follows:

Task	Weight	Due Date	Linked Learning Outcomes	Linked Graduate Capabilities
Assignment I	10%	13/9/10	1,3,4,5,6	1,2,3,4,9
Assignment II	10%	25/10/10	1,3,4,5,6	1,2,3,4,9
Oral Presentation	10%	See schedule	6	2,5
Field Report	30%	12/11/10	1,2,3,4,5,6	2,3,4,5,8,9
Final Examination	40%	November	1,3,4,5,6	1,2,3,5

Generally the assignments and the field report are to be submitted directly to myself, but if this proves difficult then they can be submitted through the FoS Centre. All assignments will need a signed cover sheet. Please note that assignments are due by no later than 5:00 pm on the due date.

## **7. Desired Standards**

<b>Grade</b>	<b>Standard Required</b>
High Distinction	Demonstrates an extensive knowledge and understanding of the concepts of the course. Analysis skills are very sophisticated with a balance of individual components and larger ideas. Capable of generalising from examples and evaluating ideas.
Distinction	Demonstrates a thorough knowledge and understanding of the concepts of the course. Analysis skills are sophisticated with a balance of individual components and larger ideas. Capable of generalising from examples and evaluating ideas.
Credit	Demonstrates a sound knowledge and understanding of the concepts of the course. Can break down complex problems into components and synthesise multiple factors into a larger idea. Can evaluate the importance and limitations of data.
Pass	Demonstrates a basic knowledge and understanding of the concepts of the course. Analysis is mainly descriptive. Demonstrates limited capacity to identify complex factors within an idea or to combine multiple factors.
Conceded Pass	Demonstrates a limited knowledge and understanding of the concepts of the course. Analysis is mainly descriptive. Demonstrates very limited capacity to identify complex factors within an idea or to combine multiple factors.
Fail	Demonstrates a poor knowledge and understanding of the concepts of the course. Analysis skills are very limited.

## **TEXTBOOK and TECHNOLOGY USED**

A DVD copy of most of the overheads and PowerPoint slides used in the running of the unit will be handed out during the first lecture. As well, copies of colour overheads and other lecture material and any new PowerPoint slides will be placed on the GEOS316 WEB page on the Online Learning @ MQ WEBSITE at <http://learn.mq.edu.au/>. You will be able to access the WEB page with your standard Macquarie student username and password. Some sections linked within the GEOS316 WEB site will have an internal username (*geos316*) and password (*you should be able to figure it out by now*), as they can be accessed external to this unit. There is no compulsory textbook for this unit, but I highly recommend that you get a copy of “*An Introduction to Geophysical Exploration*” by Kearey *et al* as it looks at the material at an appropriate level. If you already have one of the following books then that should be sufficient. The lecture material will consist of chapters and segments of several books and articles and PPT’s, but all the books below give a good grounding in geophysics, just with a different focus. The following books are on 7-day loan in the library for you to read up on relevant subjects:

Burger, H.R., *Exploration Geophysics of the Shallow Subsurface*, Prentice-Hall, 1992. [TN269.B86]

Gunn, P., *AGSO Journal of Australian Geology and Geophysics 17*, 1997. [QE340.A7]

Kearey, P., Brooks, M. and Hill, I., *An Introduction to Geophysical Exploration, 3rd Edition*, Blackwell Scientific Publications, 2002. [TN269.K36/2002]

Mussett A.E. and Khan M.A., *Looking into the Earth*, Cambridge, 2000. [QE501.M87/2000]

Parasnis, D.S., *Principles of Applied Geophysics*, 5th Edition, Chapman and Hall, 1997. [TN269.P32]

Reynolds, J.M., *An Introduction to Applied and Environmental Geophysics*, John Wiley & Sons, 1997. [QC808.5.R49]

Sharma, P.V., *Environmental and Engineering Geophysics*, Cambridge University Press, 1997. [TA705.S515]

Telford, W.N., Geldart, L.P., and Sheriff, R.E., *Applied Geophysics*, 2nd Edition, Cambridge University Press, 1990. [TN269.T44]

If you intend to enrol in GEOS315 (Environmental and Groundwater Geophysics) in the following year, it would be advisable to purchase the books by Kearey *et al*, by Telford *et al.*, and one of the two by Reynolds and Sharma, because these will be recommended textbooks for that unit and you maximise your use of them. In addition you find some useful material in *Geophysical Methods in Geology* by P.V. Sharma (it is out of print but still available in the library).

### **E-readings (<http://www.lib.mq.edu.au/reserve/>)**

The following articles are in the E-readings section of the library WEB page. Please search by author.

- Bristow Q.*, 1983. Airborne  $\gamma$ -Ray Spectrometry in Uranium Exploration. Principles and Current Practise. Int. J. Appl. Radiat. Isot. 34, 199-229.
- Clark D.A.*, 1999. Magnetic petrology of igneous intrusions: implications for exploration and magnetic interpretation. Exploration Geophysics 30, 5-26.
- Clark D. & Emerson D.W.* 1991. Notes on rock magnetization characteristics in applied geophysical studies. Exploration Geophysics 22, 547-555.
- Grasty R.L.*, 1979. Gamma Ray spectrometric methods in uranium exploration- theory and operational procedures. In, Geophysics and Geochemistry in the Search for Metallic Ores; Peter J. Hood, editor; Geological Survey of Canada, Economic Geology Report 31, 147-161.
- Irvine R.J. & Staltari G.*, 1984. Case History Illustrating Interpretation Problems in Transient Electromagnetic Surveys. Exploration Geophysics 15, 155-167.

### **EXTENSIONS AND PENALTIES:**

Whenever possible requests for an extension should be submitted prior to an assignment's due date. Late assignments will be date stamped and a penalty of 10% per day (Monday to Friday) will be deducted from the total mark.

### **ACADEMIC HONESTY AND PLAGIARISM.**

Plagiarism involves using the work of another person and presenting it as one's own. If you use the work of another person without clearly stating or acknowledging the source, you are falsely claiming that material as your own work and committing an act of **PLAGIARISM**. This is a very serious violation of good practice and an offence for which you will be penalised. You should read the University's policies and procedures on plagiarism. These can be found at: [http://www.mq.edu.au/policy/docs/academic\\_honesty/policy.html](http://www.mq.edu.au/policy/docs/academic_honesty/policy.html) The policies and procedures explain what plagiarism is, how to avoid it, the procedures taken in cases of suspected plagiarism, and the penalties if you are found guilty. Penalties may include a deduction of marks, failure in the unit, and/or referral to the University Discipline Committee.

As such, all assignments must have a signed "Faculty of Science" (FoS) assignment cover sheet attached. These sheets are available from the Science centre or from the FoS WEB page.

### **UNIVERSITY POLICIES**

Macquarie is developing a number of policies in the area of learning and teaching. Approved policies and associated guidelines and procedures can be found at Policy Central: <http://www.mq.edu.au/policy/> . There you will find the University's policy and associated procedures on assessment, Special Consideration and grade appeal.

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**SCHEDULE OF LECTURE AND PRACTICAL TOPICS, 2<sup>nd</sup> SEMESTER 2010**

<b>DATE</b>	<b>LECTURER</b>	<b>TOPIC</b>	<b>PRACTICAL</b>
Week 1 2 Aug	Mark Lackie	Introduction to the unit Geophysical Signal Processing Fourier Analysis	Signal Processing
Week 2 9 Aug	Mark Lackie	Seismic Methods: Reflection  Seismic Methods: Data Processing	Seismic Data Processing
Week 3 16 Aug	Mark Lackie	Seismic Methods: Data Processing	Seismic Data Processing
Week 4 24 Aug	Mark Lackie	<b>ASEG Conference Student Day (Tuesday)</b>	Learn heaps at conference
Week 5 30 Aug	Mark Lackie	Magnetics: Acquisition and Processing Enhancement and Presentation of data	Magnetics Exercise
Week 6 6 Sept	Dave Pratt	Potential Field Presentation and Interpretation (2-6)	Potential Field Interpretation
Week 7 13 Sept	Mark Lackie Andy Green	EM Theory Remote Sensing (2-6)	Remote Sensing Exercise
		<b>Mid Semester Recess Field Excursion (29 September - 3 October)</b>	
Week 8 4 Oct	Mark Lackie	<i>Labour Day Holiday</i>	Enjoy day off
Week 9 11 Oct	Mark Lackie Steve Webster	EM Acquisition Exploration Methodologies	Field data Compilation
Week 10 18 Oct	Mark Lackie Bruce Dickson	Radiometrics: Acquisition Radiometrics: Processing and Interpretation (2-4)	Field data Compilation
Week 11 25 Oct	Mark Lackie	IP Acquisition and Interpretation EM Interpretation	EM Exercise Field data Compilation
Week 12 1 Nov	Mark Lackie TBA	Seismic Methods: Interpretation Seismic Case Histories	Field data Compilation
Week 13 8 Nov	Mark Lackie	Petroleum Exploration Minerals Exploration	Field data Compilation

**Any resemblance between this schedule and what actually happens is entirely coincidental.**