MACQUARIE UNIVERSITY
FACULTY OF SCIENCE
DEPARTMENT OF EARTH AND PLANETARY SCIENCES
GEOS385 GLOBAL TECTONICS
First Semester 2011

UNIT OUTLINE

INTRODUCTION

Integrated geophysical and petrological methodologies are used to explore global tectonics. Recent advances in our knowledge of the structure, composition, and history, of the lithosphere will be assessed. The motion of lithospheric plates over the surface of the Earth at the present day will be investigated, as will the drift of continents and continental reconstructions through time, as inferred from geophysical, palaeomagnetic, and geological evidence. The mechanisms of plate tectonics, supercycles and recent developments in understanding mantle/lithosphere dynamics will be addressed. Our current understanding of the differentiation of the planet and the earth's early history will be assessed as will our current ideas on the process of convection of the mantle. A synthesis of the tectonic history of Australia and its neighbours in Gondwanaland during the past billion years will be presented.

UNIT TOPICS

The major topics to be studied will include:

Plate Motions: Current.

Plate Motions: In the past.

Seismology: The structure and nature of the interior of the earth.

4D Lithospheric Mapping, Plumes, Hotspots, Global Volcanism.

Time scales of magmatic processes.

Global tectonics of Australia.

Differentiation of the planet and early earth history.

Mantle Convection.

UNIT ORGANISATION.

Credit Points: 3
Please note that in 2010, this unit ran as a 4 cp unit, GEOS386.

Prerequisites: GEOS260 or GEOS206 and GEOS268 or GEOS205

A list of important dates for this year is attached.
There will be two lectures (each one hour) and a three-hour practical session on each of the 13 weeks of first semester.

Lecture Times

Time: Lecture: Monday Noon to 1:00 pm
Lecture: Monday 2:00 pm to 3:00 pm
Practical: Monday 3:00 pm to 6:00 pm

Venue: Building E5A Room132

STAFF

Mark Lackie
E7A Room 518
Phone 98508377
email mark.lackie@mq.edu.au

Craig O'Neill
E7A Room 515
Phone 98509673

Sue O'Reilly
E7A Room 504
Phone 98508362

Simon Turner
E5B Room 215
Phone 98508363

Yingjie Yang
E7A517
Phone 98508414

KEY LEARNING OUTCOMES

The key learning outcomes for this unit are:

1. understanding of issues concerning the global tectonics of the earth;
2. understanding of mantle and lithosphere dynamics;
3. understanding of the basic concepts of tectonic plate motions;
4. understanding scientific methodology;
5. competence in accessing, using and synthesising appropriate information;
6. application of knowledge to solving problems and evaluating ideas and information; and
7. 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.

No.	Capability	Brief Description
1	*Discipline Specific Knowledge and Skills*	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	*Critical, Analytical and Integrative Thinking*	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	*Problem Solving and Research Capability*	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	*Creative and Innovative*	Graduates will be capable of creative thinking and of creating knowledge.
5	*Effective Communication*	Students develop the ability to communicate and

		convey their views in forms effective with different audiences.
6	*Engaged and Ethical Local and Global citizens*	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	*Socially and Environmentally Active and Responsible*	Graduates to be aware of and have respect for self and others.
8	*Capable of Professional and Personal Judgement and Initiative*	Graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement.
9	*Commitment to Continuous Learning*	Graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake.

UNIT ASSESSMENT

The unit will be assessed as follows:

Task	**Weight**	**Due Date**	**Linked Learning Outcomes**	**Linked Graduate Capabilities**
Assignment I	10%	21/3/11	1,2,4,5,7	1,2,3,4,5,9
Assignment II	10%	16/5/11	1,3,4,6	1,2,3,9
Research Paper & seminar & GMT	30% (20% + 5% + 5%)	23/5/11	1,5,7	2,5,8,9
Final Examination	50%	June	1,2,3,4,5,6,7	1,2,3,5

The minimum requirements needed to obtain a passing grade for the unit are:

(i) A passing grade in the assignments and research paper (as a whole)

(ii) A passing grade in the examination.

DESIRED STANDARDS

Grade	**Standard Required**
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 (sorry in 2011, this means you failed)	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

The textbook for the unit is "The Solid Earth (2nd Ed)" by Fowler. The book "Global Tectonics" by Kearey, Klepeis & Vine is a useful text and worth considering.

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 PowerPoint's 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. As well, this site will access the on-line quizzes that will need to be completed during the semester. 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 GEOS385 WEB site. Please note that some sections within the WEB site require an internal username and password; the username is **geos385** and please see, or call me to obtain the password. Information for students about access to online units is available at https://learn.mq.edu.au/webct/RelativeResourceManager/25994001/Public%20Files/uw/software.html

Below is a list of references that may be helpful in expanding certain aspects of the unit.

REFERENCES

QC806.A515	Anderson D.L., Theory of the Earth, 1989
QE501.A7513/1984	Artyushkov E.V., Geodynamics
QB501.N47	Beatty J.K. & Chaikin A. (Eds), The New Solar System (3rd ed.), 1990
QE509.B75	Bott M.P., The interior of the Earth (2nd ed.), 1982
QE501.4.P35.B88	Butler R.F., Paleomagnetism, 1991
QE527.7 .C66/2001	Candie K.C., Mantle Plumes and their record in Earth History, 2001
QC806.C65	Cook A.H., Physics of the Earth and Planets, 1973
QE511.4.C683/1986	Cox A. & Hart R.B., Plate tectonics: how it works, 1986
QE509.4.D38/1999	Davies G.F., Dynamic Earth, Plates, Plumes and Mantle Convection, 1999
QC806.D39	De Bremaecker J-C, Geophysics: The earth's Interior, 1985
QB501.N18	Dermott S.F. (Ed), The origin of the Solar System, 1977
QE501.E67/1990	Ernst W.G., The Dynamic Planet
QC806.F625	Fowler C.M.R., The Solid Earth, 1990
QC806.F625/2005	Fowler C.M.R., The Solid Earth (2nd Ed), 2005
QC827.I7	Irving E., Paleomagnetism, 1964
QE509.E234/1998	Jackson I, The Earth's Mantle, 1998
QE509.J27/1992	Jacobs J.A. Deep Interior of the Earth, 1992
QE509.E232/2000	Karato S. et al, Earth's Deep Interior, 2000
QE511.4.K43/1996	Kearey P. & Vine F.J., Global Tectonics (2nd Ed), 1996
QE511.4.K43/2009	Kearey P., Klepeis K.A. & Vine F.J., Global Tectonics (3rd Ed), 2009
QE35.E18	McElhinny M.W., The Earth, its Origin, Structure and Evolution, 1979
QE501.4.P35.M35/2000	McElhinny M.W. & McFadden, Paleomagnetism: continents and oceans, 2000
QC816.M4	Merrill R.T. & McElhinny M.W., The Earth's Magnetic Field, 1983
QC816.M47/1996	Merrill R.T., McElhinny M.W. & McFadden P.L. The magnetic field of the Earth: palaeomagnetism, the core, and the deep mantle, 1996
QE511.4.H57/2000	Richards et al, The History and Dynamics of Global Plate Motions, 2000
QE501.S3/1982	Scheidegger A.E., Principles of Geodynamics
QC806.S54/1997	Sleep N.H. & Fujita K., Principles of Geophysics, 1997
QE26.2.C35	Smith D.G. (Ed), The Cambridge Encyclopaedia of Earth Sciences
QC806.S65	Stacey F.D., Physics of the Earth (2nd & 3rd eds.), 1977 & 1992
QE511.44.G46	Summerfield M.A., Geomorphology and Global Tectonics, 2000
QE501.T83	Turcotte D.L. & Schubert G., Geodynamics, 1982
QE340.B55	Veevers J. J., Billion-year earth history of Australia and neighbours in Gondwanaland, 2000
QE340.B552	Veevers J.J., ATLAS of Billion-year earth history of Australia and neighbours in Gondwanaland, 2001

7-Day Loan

Veevers J.J., Billion-year earth history of Australia QE340.B55

Veevers J.J., ATLAS of Billion-year earth history of Australia	QE340.B552
Kearey P., Klepeis K.A. & Vine F.J., Global Tectonics	QE511.4.K43/2009
Butler R.F., Paleomagnetism	QE501.4.P35.B88
Condie K.C, Mantle Plumes and their record in Earth History	QE527.7 .C66/2001
Fowler C.M.R., The Solid Earth	QC806.F625/2005

ASSIGNMENTS

I. The Lithosphere.

II. Plate motions.

RESEARCH PAPER

This assignment will consist of a paper, which results from your reading on an individually selected topic. The paper you submit should be in the form of a paper for submission to the journal; *Journal of Geophysical Research*. It should be typed, double spaced, and about 2000 to 3000 words in length and adequately illustrated with appropriate figures.

Topics will be related to the tectonic and geological history of Australia or a neighbouring lithospheric plate. As well, you will also complete a GMT exercise related to your chosen topic. At the end of the semester, in week 13, you will be required to give a seminar about your research topic. The length of the seminar should be about 15 minutes plus a couple of minutes for questions. The seminar should give us a basic outline of your region, it's history, what is the currently accepted wisdom?, etc. The seminar will be assessed.

EXAMINATION

The final two-hour exam will consist of questions to be answered in essay style and will cover all aspects of the unit.

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
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.

SCHEDULE OF LECTURE TOPICS, 2011

Week	Lecturer	Topic
Week 1 21 Feb	Mark Lackie Craig O'Neill	Introduction Early Earth history and the core
Week 2 28 Feb	Craig O'Neill	The Mantle Hotspots and convection
Week 3 7 March	Yingjie Yang Sue O'Reilly	Seismology 4D Lithosphere Mapping
Week 4 14 March	Sue O'Reilly	Archean Lithosphere Formation Plumes and how the Earth works.
Week 5 21 March	Mark Lackie	Plates and plate margins Plate Motion
Week 6 28 March	Mark Lackie	Triple Junctions Tectonics on a sphere
Week 7 4 April	Craig O'Neill Mark Lackie	Gravity and the Geoid Finite Rotations
RECESS		
Week 8 25 April		**Anzac Day**
Week 9 2 May	Simon Turner	Uranium Series : The basics Time scales of magmatic processes
Week 10 9 May	Craig O'Neill	Heat Even more heat
Week 11 16 May	Mark Lackie	Marine magnetic anomalies Palaeomagnetism
Week 12 23 May	Mark Lackie	Continental reconstructions: The palaeomagnetic viewpoint
Week 13 30 May	The class	**Seminars**

Mark Lackie
Unit Convenor