



# GEOS344

## Structural and Metamorphic Geology

S2 Day 2014

*Earth and Planetary Sciences*

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## General Information

Unit convenor and teaching staff

Unit Convenor

Stephen Foley

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Contact via 9452

E7A 429

Credit points

3

Prerequisites

GEOS207 and (GEOS226 or GEOS272)

Corequisites

Co-badged status

Unit description

This unit embodies a detailed description of the chemical and mineralogical composition of the crust and uppermost 200 km of the mantle. Themes covered include the composition of the mantle and the melts it can give rise to, the mineralogical makeup and textures of metamorphic crustal rocks, and a characterization of the assemblages of rocks that are typical for various tectonic environments on the modern and ancient Earth. Emphasis is laid on integrating information from different sub-disciplines of the Earth sciences. Practical work comprises exercises on metamorphic and igneous rocks and builds an understanding of the intimate relationship between geochemistry and petrology.

## 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:

To gain an appreciation of the mineralogy of mantle rocks and of the conditions at, and processes by, which they may melt.

To gain an appreciation of the relationship between mineral assemblages, mineral composition, and the geochemistry of the rocks they are contained in.

To be able to recognize metamorphic mineral assemblages under the petrographic

microscope and to be able to assign these to their metamorphic pressure-temperature conditions of origin.

To read and interpret basic geological phase diagrams.

To gain an overview of the rock types (igneous, metamorphic and sedimentary) to be expected in specific geotectonic environments, and so be able to recognize geological settings in the Earth's past.

To further develop skills in teamwork, independent observations, and written presentation of scientific information.

## Assessment Tasks

Name	Weighting	Due
<u>Quizzes</u>	15%	TBA
<u>Practical assignments</u>	45%	TBA
<u>Final examination</u>	40%	Examination period

### Quizzes

Due: **TBA**

Weighting: **15%**

3 quizzes during semester, each worth 5% of total mark

On successful completion you will be able to:

- To gain an appreciation of the relationship between mineral assemblages, mineral composition, and the geochemistry of the rocks they are contained in.
- To be able to recognize metamorphic mineral assemblages under the petrographic microscope and to be able to assign these to their metamorphic pressure-temperature conditions of origin.
- To read and interpret basic geological phase diagrams.

### Practical assignments

Due: **TBA**

Weighting: **45%**

Practical work done in the three-hour practical classes will be collected in and marked on three occasions.

Marks will be 15% for each practical collected in, totalling 45% for the course.

Whether a given week's practical work will be collected in for marking will be announced at the

beginning of the practical session.

On successful completion you will be able to:

- To gain an appreciation of the mineralogy of mantle rocks and of the conditions at, and processes by, which they may melt.
- To gain an appreciation of the relationship between mineral assemblages, mineral composition, and the geochemistry of the rocks they are contained in.
- To be able to recognize metamorphic mineral assemblages under the petrographic microscope and to be able to assign these to their metamorphic pressure-temperature conditions of origin.
- To read and interpret basic geological phase diagrams.
- To further develop skills in teamwork, independent observations, and written presentation of scientific information.

## Final examination

Due: **Examination period**

Weighting: **40%**

The examination will consist partly of questions on the material covered in lectures and partly of practical work on microscopy, which will be covered in the three -hour practicals after the mid-term break.

On successful completion you will be able to:

- To gain an appreciation of the mineralogy of mantle rocks and of the conditions at, and processes by, which they may melt.
- To gain an appreciation of the relationship between mineral assemblages, mineral composition, and the geochemistry of the rocks they are contained in.
- To be able to recognize metamorphic mineral assemblages under the petrographic microscope and to be able to assign these to their metamorphic pressure-temperature conditions of origin.
- To gain an overview of the rock types (igneous, metamorphic and sedimentary) to be expected in specific geotectonic environments, and so be able to recognize geological settings in the Earth's past.
- To further develop skills in teamwork, independent observations, and written presentation of scientific information.

## Delivery and Resources

### Required and Recommended Texts and/or Materials

There is no set textbook for GEOS344.

The following books have been taken as sources for many graphics used in lectures. Others come from scientific journal publications: these will be made available on-line (iLearn) as the course proceeds.

Winter, J.D. (2010) Principles and igneous and metamorphic geology. Pearson education. ISBN-10: 0321592573

Best, M.G. (2003) Igneous and metamorphic petrology. Blackwell. ISBN-10: 1405105887

Putnis, A. (1992) Introduction to mineral sciences. Cambridge. ISBN-10: 0521429471

Bucher, K., Grapes, R. (2011) Petrogenesis of metamorphic rocks. Springer. ISBN-10: 3540741682

Philpotts, A.R., Ague, J.J. (2009) Principles of igneous and metamorphic petrology. Cambridge. ISBN-10: 0521880068

Blatt, H., Tracy, R., Owens, B. (2005) Petrology: igneous, sedimentary and metamorphic. W.H. Freeman. ISBN-10: 0716737434

Spry, A. (1969) Metamorphic textures. Pergamon Press.

Spear, F. S. (1994) Metamorphic phase equilibria and pressure-temperature-time paths. Mineralogical Society of America Monograph. ISBN 0-939950340

Vernon, R. H., Clarke, G.L. (2008) Principles of metamorphic petrology. Cambridge. ISBN-10: 0521871786

Nesse, W.D. (2011) Introduction to mineralogy. Oxford. ISBN-10: 0199827389

#### Library Loans

The Library at Macquarie will have provided you with information on library loans. The procedures differ for metropolitan and country students. Please familiarise yourself with the procedures appropriate in your case. If you have any enquiries contact the Library on (02) 9850-7500.

### Technology Used and Required

Unit Web Page

<http://ilearn.mq.edu.au>

## Unit Schedule

Wk	Lecture	Practical
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1	Composition and mineralogy of the mantle	Binary phase diagrams - a refresher
2	Melting conditions and melting in the mantle	Mineral formulae and the chemical composition of minerals
3	Phase diagrams and thermodynamic ground rules	Ternary phase diagrams
4	Composition and evolution of the continental crust	Fractional crystallization and melting in phase diagrams
5	Mantle metasomatism and melt generation	Chemical composition of rock types; element partitioning
6	Metamorphism, zones, facies and classification	Partial melting and trace element behaviour
7	Graphical representation of mineralogy and reactions in metamorphism	Chemographic representation of metamorphic mineral reactions
8	Rock composition and mineralogy in metamorphism	Microscopy of mantle rocks
9	The effects of water in metamorphism	Microscopy of metapelites
10	Plate tectonic settings 1: rock assemblages in continental rifts	Microscopy of metabasites
11	Plate tectonic settings 2: rock assemblages at convergent margins	Textures of metamorphic rocks
12	Plate tectonic settings 3: rock assemblages in the evolution of the Earth	Microscopy revision and oddities
13	Revision	

## 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/)

## 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](http://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](http://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

### 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**

- To gain an appreciation of the mineralogy of mantle rocks and of the conditions at, and processes by, which they may melt.
- To gain an appreciation of the relationship between mineral assemblages, mineral composition, and the geochemistry of the rocks they are contained in.
- To be able to recognize metamorphic mineral assemblages under the petrographic microscope and to be able to assign these to their metamorphic pressure-temperature conditions of origin.
- To further develop skills in teamwork, independent observations, and written presentation of scientific information.

## **Assessment tasks**

- Practical assignments
- Final examination

## **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**

- To gain an appreciation of the mineralogy of mantle rocks and of the conditions at, and processes by, which they may melt.
- To gain an appreciation of the relationship between mineral assemblages, mineral composition, and the geochemistry of the rocks they are contained in.
- To be able to recognize metamorphic mineral assemblages under the petrographic microscope and to be able to assign these to their metamorphic pressure-temperature conditions of origin.



- To read and interpret basic geological phase diagrams.
- To gain an overview of the rock types (igneous, metamorphic and sedimentary) to be expected in specific geotectonic environments, and so be able to recognize geological settings in the Earth's past.

## **Assessment tasks**

- Quizzes
- Practical assignments
- Final examination

## **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**

- To gain an appreciation of the mineralogy of mantle rocks and of the conditions at, and processes by, which they may melt.
- To gain an appreciation of the relationship between mineral assemblages, mineral composition, and the geochemistry of the rocks they are contained in.
- To be able to recognize metamorphic mineral assemblages under the petrographic microscope and to be able to assign these to their metamorphic pressure-temperature conditions of origin.
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- To further develop skills in teamwork, independent observations, and written presentation of scientific information.

## **Assessment tasks**

- Quizzes
- Practical assignments
- Final examination

## 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

- To gain an appreciation of the mineralogy of mantle rocks and of the conditions at, and processes by, which they may melt.
- To gain an appreciation of the relationship between mineral assemblages, mineral composition, and the geochemistry of the rocks they are contained in.
- To be able to recognize metamorphic mineral assemblages under the petrographic microscope and to be able to assign these to their metamorphic pressure-temperature conditions of origin.
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- To further develop skills in teamwork, independent observations, and written presentation of scientific information.

### Assessment tasks

- Practical assignments
- Final examination

## 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 outcome

- To gain an overview of the rock types (igneous, metamorphic and sedimentary) to be expected in specific geotectonic environments, and so be able to recognize geological settings in the Earth's past.

## Assessment tasks

- Practical assignments
- Final examination

## 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 outcome

- To further develop skills in teamwork, independent observations, and written presentation of scientific information.

## Assessment task

- Final examination

## Changes from Previous Offering

GEOS 344 is undergoing a metamorphosis (how fitting), which will be completed next year. In 2014, the course is about 60% changed from last year's on metamorphic and structural geology to its goal of "Petrology and Geodynamics of the Lithosphere." Structural content has been moved to GEOS 307. Participants should bear these changes in mind if consulting students who have previously completed GEOS 344.

## Changes since First Published

Date	Description
25/07/2014	Only section "Delivery and Resources" has been changed. Reading list was still the old one. Sorry.