



**UNSW**  
THE UNIVERSITY OF NEW SOUTH WALES

## **SCHOOL OF BIOLOGICAL, EARTH AND ENVIRONMENTAL SCIENCES**

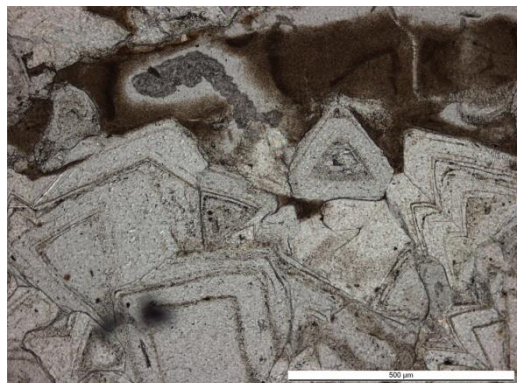
### **GEOS2181 EARTH MATERIALS**

#### **Session 2, 2018**

An introduction to the identification, classification, formation and analysis of minerals, rocks, meteorites, gems and sediments. Crystal growth, atomic structure, composition, properties and classification of minerals, with special reference to the rock-forming and clay minerals. Mineral analysis techniques including chemical methods and X-ray diffraction; application of geochemical studies including introduction to radiometric dating. Genesis, analysis and classification of igneous, metamorphic and sedimentary rock types. Optical properties of minerals and rocks under the polarising microscope.

**Course co-ordinator: Dr Ian Graham**

## **COURSE MANUAL**



## SCHEDULE

| Week | Date    | Content<br>Labs (2 hours)<br>Days: Monday 10–12 am OR<br>Monday 1–3 pm<br>Room: Building E26 lab 5 | Lect<br>Staff | Content<br>Lectures<br>Monday, 9–10 am Central Lecture Block 5<br>Tuesday, 11–12 am Mathews D    |                    | Assesments Due   |
|------|---------|--|---------------|--|--------------------|------------------|
| 2    | Jul 30  | Minerals in Hand-specimen I  | ITG<br>ITG    | Getting to know you activity<br>Course overview/Mineral Properties in Hand Specimen.             | Jul 30<br>Jul 31   |                  |
| 3    | Aug 6   | Minerals in Hand-specimen II   | ITG<br>ITG    | Introduction to Mineralogy<br>Introduction to Optical Mineralogy                                 | Aug 6<br>Aug 7     | Quiz 1           |
| 4    | Aug 13  | Intro to Petrological microscopes/Minerals in Thin-section I                                       | DC<br>DC      | Introduction to Geochemistry<br>Introduction to Geochronology                                    | Aug 13<br>Aug 14   | Quiz 2           |
| 5    | Aug 20  | Minerals in Thin-section II  | ITG<br>ITG    | Mineral Groups<br>Gem Materials  | Aug 20<br>Aug 21   | Quiz 3           |
| 6    | Aug 27  | Igneous Rocks I  | ITG<br>ITG    | Igneous Processes I<br>Igneous Processes II  | Aug 27<br>Aug 28   | Quiz 4           |
| 7    | Sept 3  | Igneous Rocks II   | ITG<br>ITG    | Classification and Naming of Igneous Rocks<br>Cenozoic Intraplate Volcanism in eastern Australia | Sept 3<br>Sept 4   | Quiz 5           |
| 8    | Sept 10 | Sedimentary Rocks  | ITG<br>ITG    | Sedimentary Processes I<br>Sedimentary Processes II  | Sept 10<br>Sept 11 | Quiz 6           |
| 9    | Sept 17 | <b>All day field trip</b>  | ITG           | <b>All day field trip</b>  | Sept 17            |                  |
|      |         | <b>Mid-session break 22 Sept to 1 Oct</b>  |               | <b>Mid-session break 22 Sept to 1 Oct</b>  |                    |                  |
| 10   | Oct 1   | <b>Public Holiday</b>  | ITG           | <b>Public Holiday</b><br>Sedimentary Processes III   | Oct 1<br>Oct 2     | Quiz 7           |
| 11   | Oct 8   | X-ray Diffraction Techniques   | ITG<br>ITG    | Clays and Clay Minerals<br>Sedimentary Processes IV  | Oct 8<br>Oct 9     | Fieldtrip Report |
| 12   | Oct 15  | Processing and Interpretation of Geochemical Data in Igneous Petrology                             | ITG<br>ITG    | Analytical Techniques<br>Extraterrestrial Materials  | Oct 15<br>Oct 16   | Quiz 8           |
| 13   | Oct 22  | Lab Skills Test  | ITG<br>ITG    | Metamorphic Rocks and Processes<br>Course and Final Exam Overview                                | Oct 22<br>Oct 23   | Lab Skills Test  |

# GEOS2181

## Earth Materials

**Laboratory:** Monday 10 – 12 am Building E26 Lab 5  
Thursday 1 – 3 pm Building E26 Lab 5

**Lecture:** Monday 9 – 10 am Central Lecture Block 5  
Tuesday 11 – 12 am Mathews Theatre D

**Field Tutorial:** Monday 17th September, Kulnura Quarry, Central Coast  
8 am (leave UNSW) – 4 pm (return UNSW) (via Nth Shore)

**Coordinator:** Dr Ian Graham  
Room 535, Link Wing  
Extension 58720  
E-mail: [i.graham@unsw.edu.au](mailto:i.graham@unsw.edu.au)

**Lecturers:** A/Prof David Cohen  
Room G, Biological Sciences Building  
E-mail: [d.cohen@unsw.edu.au](mailto:d.cohen@unsw.edu.au)

**Demonstrators:** Elizabeth Liepa  
Email:

**Credit:** 6 units of credit

**Level:** Undergraduate II

**Consultation:** By arrangement with staff members.

**Consideration:** Medical certificate presented within 7 days of lecture, laboratory or assessable exercise. Late assignments will receive a penalty of 5% per day overdue.

**Prerequisite:** GEOS1111 or GEOS1211.

**Objectives:** To provide a theoretical and practical introduction to the scientific study of minerals (mineralogy) and rocks (petrology), and to the principal techniques for mineralogical, petrological and geochemical analysis. To provide an understanding of the nature and origin of minerals, rocks and sediments, as a basis for further studies in the Earth and Environmental Sciences.

## ASSESSMENT

|                   | Value | Due                |
|-------------------|-------|--------------------|
| Weekly quizzes    | 20%   | Oct 5 (week 11)    |
| Fieldtrip report  | 10%   | Oct 8 (week 11)    |
| Lab Skills Test   | 20%   | Oct 22 (week 13)   |
| Final examination | 50%   | Date to be advised |

## LIST OF QUIZZES

| Quiz | Topic  | Day          |
|------|--|--------------|
| 1    | Properties of minerals in hand-specimen          | 6 August     |
| 2    | Minerals in hand-specimen/Intro to Mineralogy    | 13 August    |
| 3    | Geochemistry/Geochronology/Optical Mineralogy    | 20 August    |
| 4    | Properties of minerals in thin-section           | 27 August    |
| 5    | Mineral groups/Gem Materials                     | 3 September  |
| 6    | Igneous Processes/Igneous rocks                  | 10 September |
| 7    | Fieldtrip/Sedimentary Rocks                      | 8 October    |
| 8    | Clays and Clay Minerals/X-ray diffraction        | 15 October   |
| 9    | Review of whole course (lectures and practicals) | 22 October   |

## GRADUATE ATTRIBUTES DEVELOPED IN THIS COURSE<sup>1</sup>

| Science Graduate Attributes <sup>5</sup>            | Focus<br><i>0 = no focus<br/>1 = minimal<br/>2 = minor<br/>3 = major</i>  | Activities / Assessment   |
|---|---|---|
| Research, inquiry and analytical thinking abilities | 2   | Literature reviews and critique of papers. Conduct and interpret of results of field work. Weekly quizzes |
| Ethical and professional understanding              | 0   |   |
| Communication                                       | 3   | Essay, major report on field work   |
| Teamwork, collaborative and management skills       | 2   | Field and laboratory work.  |
| Information literacy                                | 3   | Use of information resources for essay, and field report.   |
| Relationship to Other Courses within the Program    | The course is core to earth science and related majors. The course is supported by level 1 courses in GEOS and CHEM. The course is complementary to GEOS3171 (Earth Structures). It is preparation for most upper level GEOS courses involving physical sciences. |   |

<sup>1</sup> Access the contextualised Science Graduate Attributes and your mapped courses:  
<http://www2.science.unsw.edu.au/guide/slatig/sciga.html> (Mapped courses are available at this site)

## RATIONALE AND STRATEGIES UNDERPINNING THE COURSE

|  |  |  |
|--|--|--|
| <b>Teaching Strategies</b>   | The structure of the course is built around the lectures and associated readings indicated by the staff. This content will be supplemented by the student seminars on diverse mineralogical and petrological topics. The concepts discussed in the lectures are then reinforced through both the laboratory and fieldwork.   |  |
| <b>Rationale for learning and teaching in this course<sup>2</sup>,</b> | <p><b>Guidelines on teaching:</b></p> <ol style="list-style-type: none"> <li>1. A climate of enquiry should be developed where students feel challenged</li> <li>2. Activities should be interesting and challenging</li> <li>3. Material must be perceived as relevant to future study or professional practice</li> <li>4. There must be dialogue/interaction between lecturers and students</li> <li>5. There should be multiple teaching methods</li> <li>6. Goals, outcomes and requirements of the course must be clearly articulated</li> <li>7. Students are to be encouraged to take responsibility for own learning</li> <li>8. Broad graduate attributes must be developed</li> <li>9. Co-operative work with peers assists learning</li> </ol> | <p><b>Application to course:</b></p> <ol style="list-style-type: none"> <li>1. <i>Emphasis of the complexity of geological systems</i></li> <li>2. <i>Fieldwork to underpin lectures/labs with open-ended scope of work for report. Focus on practical experiences</i></li> <li>3. <i>Emphasis as to underpinning of geology by mineralogy and petrology.</i></li> <li>4. <i>Labs and fieldwork will emphasise this.</i></li> <li>5. <i>Lectures, labs, fieldwork, readings</i></li> <li>6. <i>The relevance of each topic and the purpose and outcomes of the prac work will be discussed</i></li> <li>7. <i>Essays and seminars require students to undertake largely undirected lit. review</i></li> <li>8. <i>See above</i></li> <li>9. <i>Some of the work is group-based, though most reporting is individual</i></li> </ol> |

## RESOURCES

### Mineralogy

- Klein, C., and Dutrow, B., 2008.** *The Manual of Mineral Science* (23<sup>rd</sup> Edition). John Wiley and Sons.
- Klein, C., 2008.** *Minerals and Rocks* (3<sup>rd</sup> Edition). John Wiley and Sons.
- Deer, W.A, Howie, R.A. and Zussman, J., 1992.** *Introduction to the Rock Forming Minerals*. Longman.
- Wenk, H-R., and Bulakh, A., 2004.** *Minerals: their constitution and origin*. Cambridge University Press.

### Optical Mineralogy

- Nesse, W.D., 2004.** *Introduction to Optical Mineralogy* (3<sup>rd</sup> Edition). Oxford University Press.
- Gribble, C.D., and Hall, A.J., 1985.** *A Practical Introduction to Optical Mineralogy*. George Allen and Unwin.
- MacKenzie, W.S. and Guildford, C., 1980.** *Atlas of Rock-forming Minerals in Thin Section*, Longman
- MacKenzie, W.S. and Adams, A.E., 2000.** *A Colour Atlas of Rocks and Minerals in Thin Section*. Manson Publishing.
- Perkins, D. and Henke, K.R., 2004.** *Minerals in Thin Section* (Second Edition). Pearson Education Inc.

<sup>2</sup> LTU – Teaching Philosophy: [http://www.ltu.unsw.edu.au/content/teaching\\_support/teaching\\_portfolio.cfm?ss=0#putting](http://www.ltu.unsw.edu.au/content/teaching_support/teaching_portfolio.cfm?ss=0#putting)

- Crystals**                      **Sunagawa, I., 2005.** *Crystals: growth, morphology and perfection.* Cambridge University Press.
- Clay Mineralogy**            **Velde, B., 1992.** *Introduction to Clay Minerals.* Chapman and Hall.
- Earth Materials**              **Klein, C., and Philpotts, A., 2013.** *Earth materials: Introduction to Mineralogy and Petrology.* Cambridge University Press.
- Sediment. Petrology**        **Tucker, M.E., 1981.** *Sedimentary Petrology: an introduction.* Blackwells Scientific.  
**Boggs, S., 1992.** *Petrology of sedimentary rocks.* Macmillan Press.
- Igneous Petrology**            **McBirney, A.R., 2007.** *Igneous Petrology* (3<sup>rd</sup> Edition). Jones and Bartlett.
- General Petrology**            **Blatt, H., Tracey, R.J. and Owens, B.E., 2006.** *Petrology: Igneous, Sedimentary and Metamorphic* (Third Edition). W.H. Freeman
- Geochemistry**                 **Dickin, A.P., 2000.** *Radiogenic Isotope Geology.* Cambridge University Press.  
**Faure, G., 2001.** *Origin of Igneous Rocks: the isotopic evidence.* Springer.  
**Faure, G., 2003.** *Principles and Applications of Isotope Geochemistry.* Macmillan.  
  
**Rollinson, H., 1993.** *Using Geochemical Data: evaluation, presentation and interpretation.* Longman Scientific.

**Useful Web Sites:**

Links for Mineralogists, University of Wurzburg:

<http://www.uni-wuerzburg.de/mineralogie/links.html>

University of Oxford (Dave Waters), Mineralogy Links:

<http://www.earth.ox.ac.uk/~davewa/minerals.html>

Mineralogical data base:

<http://www.mindat.org>

Interested in Minerals? Join the **Mineralogical Society of New South Wales**. It's an amateur society for people interested in collecting and learning more about minerals. Meetings are held the first Friday of every month at the Parramatta Campus of the University of Western Sydney. Details can be found at <http://www.minsocnsw.org.au>.

**Marking Criteria:**

| <b><i>Component</i></b>        | <b><i>Pass / Credit</i></b>   | <b><i>Distinction / High Distinction</i></b>   |
|--------------------------------|---|--|
| <i>Field Trip Report (10%)</i> | <p>Adequate description of work done including presentation of observations.</p> <p>Basic data interpretation and the drawing of key conclusions from results.</p> <p>Use of relevant literature.</p> <p>Use of clear technical English and effective structure</p> | <p>Detailed description of all key aspects of work done in field, including presentation of observations, with some explanation of their significance in the study.</p> <p>Superior skills in presentation of results.</p> <p>Detailed interpretation of results drawing out most of the key features of the data and extending beyond the directions of course staff.</p> <p>Reference to key literature to support interpretation.</p> <p>Use of clear technical English and effective structure in reports.</p> |
|                                |   |  |
|                                |   |  |



## PLAGIARISM

Plagiarism is a serious offence, and evidence that suggests class assignments or laboratory practical classes have been plagiarised will potentially result in findings of student misconduct and a range of penalties from loss of marks to exclusion from the University.

The following excerpts have been taken from the UNSW Learning Centre website to inform you as to what constitutes plagiarism, outline the common forms of plagiarism, and guide you on how to avoid plagiarism. For more information regarding the issue of plagiarism and how to avoid it visit the UNSW Learning Centre website at [www.lc.unsw.edu.au/onlib/plag.html](http://www.lc.unsw.edu.au/onlib/plag.html).

### What is Plagiarism?

***“Plagiarism is using the words or ideas of others and presenting them as your own. Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement.”***

### Common Forms of Plagiarism

- *Downloading assignments from an online source and submitting it as your own work;*
- *Buying, stealing or borrowing an assignment and submitting it as your own work;*
- *Copying a section of a book or an article and submitting it as your own work;*
- *Quoting from a source 'word for word', without using quotation marks;*
- *Copying, cutting and pasting text from e-sources and submitting as your own work;*
- *Using the words of someone else and presenting them as your own;*
- *Using significant ideas from someone else and presenting them as your own.*
- *Putting someone else's ideas into your own words and not acknowledging the source of the ideas;*
- *Copying the written expressions of someone else without proper acknowledgement;*
- *Relying too much on other people's material.*

Submitting an assessment item that has already been submitted for academic credit elsewhere may also be considered plagiarism. Knowingly permitting your work to be copied by another student may also be considered to be plagiarism. An assessment item produced in oral, not written form, or involving live presentation, may similarly contain plagiarised material.

***The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline (i.e. giving an appropriate reference) does not amount to plagiarism.***

Students are reminded of their Rights and Responsibilities in respect of plagiarism, as set out in the University Undergraduate and Postgraduate Handbooks, and are encouraged to seek advice from academic staff whenever necessary to ensure they avoid plagiarism in all its forms. The Learning Centre provides online resources for staff and student information on plagiarism and academic honesty. It can be located at: [www.lc.unsw.edu.au/plagiarism](http://www.lc.unsw.edu.au/plagiarism)

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use and attribution for a range of materials including text, images, formulae and concepts.

Students are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting, and the proper referencing of sources in preparing all assessment items.

### How to Avoid Plagiarism

- *Be aware of what constitutes plagiarism*
- *Plan your work*
- *Learn how to acknowledge your sources of information*

### Submission of Assignments

All assignments and assessment items should be submitted with a signed Assessment Cover Sheet (available from the BEES Student Office) which includes a declaration as to the originality of the work.

## CONDITIONS OF ENTRY TO COURSES

To abide with Section 17 (1) (Persons in control of workplaces etc, used by non-employees to ensure health and safety) and Section 19 (Employees at work to take care of others and to co-operate with employer) of the **N.S.W. Occupational Health & Safety Act (1983)**

1. (a) All persons entering UNSW property are required to wear sturdy shoes at all times. Thongs, sandals and open toed shoes are not acceptable; porous topped footwear (e.g. canvas on joggers) are not safe for wear in chemical laboratories.  
  
(b) Sturdy footwear is required on all field excursions and boots are strongly recommended.
2. (a) Safety goggles, masks, helmets and ear muffs must be worn when provided by supervising staff.  
  
(b) Laboratory coats must be worn when using designated School facilities (including all classes in Biological Sciences Room 401).  
  
(c) Students in second and higher years must be in possession of approved safety goggles and must wear them when within 3 metres of anyone hammering rocks.
3. Students with ongoing medical conditions, needing regular medication (e.g. diabetes, asthma, allergies, etc.), are required to inform the field excursion supervisor so that they are aware of your condition, but this information will be strictly confidential to staff members.
4. All students taking field excursions are expected to have had a *Tetanus* injection within the last 10 years. These injections are readily available at the Student Health Centre.
5. (a) The University of New South Wales is a **smoke-free work environment**, which means that smoking is prohibited inside all Buildings in the University. BEES, embracing the sciences of the outdoors, strongly support this concept of a healthy, clean-air work environment.  
  
(b) Alcohol and smoking are not permitted in University vehicles nor in vehicles hired by the University for field tutorials.
6. Students living away from home are advised to lodge the name, address, telephone number and fax number (if available) of next of kin with the School Office (Room G27).

**ENTRY TO THE SCHOOL, AND ATTENDANCE ON FIELD TUTORIALS, WILL BE DENIED TO STUDENTS WHO DO NOT ABIDE BY THESE CONDITIONS AND THEY MUST BE PREPARED FOR ANY ACADEMIC CONSEQUENCES.**

**Professor Martin van Kranendonk  
Head of School**

## OCCUPATIONAL HEALTH AND SAFETY

The following excerpts have been taken from the School of Biological Earth and Environmental Sciences (BEES) Occupational Health and Safety (OH&S) website <http://www.bees.unsw.edu.au/ohs/index.html>. They are provided in order to inform and assist you in understanding the OH&S issues your lecturers, laboratory technicians and demonstrators are required by law to implement.

If you have any issues or concerns regarding your health or safety please discuss with the Lecturer involved with this course. If you feel you need to take it further the matter should be raised with either the School Safety Officer or Head of School. The OH&S policy of the School will be explained in more detail during laboratory practicals and field tutorials.

### OH&S COMMITMENT AND POLICY

The University of New South Wales and School of Biological, Earth and Environmental Sciences (BEES) recognizes its obligations under the NSW Occupational Health and Safety Act 2000 and related legislation and is committed to providing a safe, healthy and secure learning and working environment for all students, staff, contractors and visitors. The School of BEES is bound by the UNSW Occupational Health and Safety Policy and adopts all the OHS Policies, Programs and Guidelines developed by the UNSW Risk Management Unit. Furthermore, BEES follows all the procedures and processes outlined in the UNSW Corporate OHS Management System in an effort to meet its OH&S obligations.

### OH&S RESPONSIBILITY AND ACCOUNTABILITY

The School of BEES adopts the organisational structure for the management of OH&S as outlined in UNSW OH&S Responsibility and Accountability–2001.

#### Head of School

The BEES Head of School shall ensure all activities undertaken within the school meet the University's obligations for OH&S in the workplace. In particular, the Head of School shall ensure all supervisors, staff, students, contractors and visitors are aware of their respective responsibilities and accountabilities in OH&S.



#### Safety Officer

The BEES Safety Officer shall advise the Head of School and the BEES OH&S Committee on all occupational health and safety. The Safety Officer is charged with:

- Checking the adequacy of risk assessments and fieldwork plans
- Organising training and induction courses for staff and students
- Informing both staff and student representatives of current OHS issues through School

#### Supervisors

Supervisors are those who are responsible for the allocation of tasks to staff, Honours and post graduate students and/or the oversight of laboratory or workshop practicals, field trips and contractors. The Supervisors for the GEOS2181 course are Dr Ian Graham and Professor Colin Ward.

|   |                                       |  |  |
|---|---------------------------------------|--|--|
|  |                                       |  |  |
| Dr Ian Graham<br>Course Co-ordinator and<br>Principal Lecturer                      | Dr David Cohen<br>Associate Professor | Ms Elizabeth Liepa<br>Demonstrator   |  |

**OH&S responsibilities include;**

- Inductions and Training,
- Inspections,
- Risk Assessments,
- Fieldwork Plans/Notifications,
- Standard Operating Procedures,
- Hazardous Substances,
- Reporting,

**Staff and Students**

Each member of staff is responsible for ensuring that his or her own work environment is conducive to good occupational health and safety practice by;

- Complying with all legislation and all UNSW and BEES OHS policies, procedures and instructions,
- Taking all action to avoid, eliminate or minimise hazards,
- Making proper use of all safety devices and personal protective equipment,
- Not wilfully placing at risk the health and safety of any person at the workplace by their acts or omissions,
- Seeking information or advice regarding hazards and procedures, where necessary, before carrying out new or unfamiliar work.

**EMERGENCY PROCEDURES**

If you discover an emergency situation, you must tell someone in the vicinity, activate one of the alarms or ring Security Services on x56666. Evacuation alarms should always be treated seriously.

In normal circumstances, the first indication that something is wrong is that you hear the Warning alarm, a continuous "beep...beep". This sound means that you must prepare to evacuate, that is, close windows, turn off equipment, and so on. If the alarm is not manually overridden within three minutes, the *Evacuate Signal*, a continuous "whoop...whoop" sound is heard. It is accompanied by a female voice calling on all occupants of the building to evacuate. At this point, you must leave by the nearest exit but not by the lifts.