

# DEPARTMENT OF EARTH AND PLANETARY SCIENCES

## Discipline Profile

### *Overview: Nature of the Discipline*

Earth scientists (in this document used to include geologists, geophysicists, geochemists and palaeontologists) aim to understand the way the Earth and other planets work and how Earth has evolved over the 4.6 billion years since it formed. This involves understanding the structure and composition of the interior of the Earth and the rocks at the Earth's surface, Earth's significance as a planetary body in the solar system, the nature of the surface of the Earth as it interfaces with the atmosphere, biosphere and hydrosphere and the nature of the electric, magnetic, gravity and ionic fields that influence Earth's properties.

Earth Science departments in Australian universities operate formally in different ways. Some are single entities that comprise staff of varied research interests and professional expertise and specialisations. These may span a spectrum including petrology, structural geology, tectonics, stratigraphy, sedimentology, geochemistry, palaeontology, geophysics, and economic geology. Some operate as separate departments for Geology and for Geophysics, some as departments of Earth Science. At Macquarie the Department of Earth and Planetary Sciences has teaching and research strengths in geology, geophysics, geochemistry, geodynamics, palaeontology and in astrobiology and this profile is relevant to all of these subject areas.

### *Special Features of the Disciplines*

It is impossible to prescribe "scholarship", in the discipline because of the wide spectrum of different projects. In general, research in Earth and Planetary Sciences (EPS) follows patterns mostly familiar elsewhere in the sciences: these range from the exacting and generally time-consuming accumulation of data relevant to the problem under study (by methods including laboratory work and the synthesis of published information) to the more distinctive aspect of collection of data by fieldwork. A substantial involvement of effort and time is usually required for these activities. It would be expected that ultimately the use of these datasets would lead to conceptual advances in the field of research.

Field studies commonly comprise substantial portions of both research and teaching and represent a unique aspect of the EPS disciplines that requires due recognition. The logistics involved in organising all fieldwork are considerable and require significant time inputs at all levels and is therefore distinct from most other disciplines in that regard. For example, supervision of an Honours student in the field is generally a minimum of 5 days. This is in addition to ongoing undergraduate, postgraduate student and individual research fieldwork that is part of the normal discipline pattern.

An important aspect of the "Service" component in EPS is that field trips are usually integral components of international and national conferences, symposia and workshops. It is not uncommon that geologists are required to organise fieldwork for up to 10 days for groups of up to 40 in distant locations (including arrangement of transport, accommodation, meals and safety requirements).

In recent years the role of high technology equipment has increased. Development of relevant techniques and methodologies and the overseeing of facilities has become an important relevant activity for some research areas in Geology and Geophysics and may comprise a significant part of the research and teaching effort of some staff. Research teamwork has become increasingly common because of the numerous specialised areas and expertise that may be required by individual research problems.

EPS currently has three high-profile Research Concentrations: The ARC National Key Centre for the Geochemical Evolution of Metallogeny of Continents (GEMOC), the Macquarie University Centre for Ecostratigraphy and Paleobiology (MUCEP) and the Australian Centre for Astrobiology (ACA) associated with the Department but administratively located in the Division of the Vice Chancellor. Until its term expired in 2000 the Department also included the Commonwealth Cooperative Research Centre for Australian Mineral Exploration Technologies (CRCAMET).

The Department is currently about close to completing the staff replacement process expected as the discipline completes 35 years of teaching and research at Macquarie. The continuation of this renewal process continues to be pursued in the Department, the Division with the help and advice of the Deputy Vice-Chancellor, Academic. There is still a gender imbalance with too few women staff across Geology and Geophysics (although better in this regard than many similar departments in Australia) and women are being encouraged to apply for new positions.

## ***Qualifications***

Staff at all levels are encouraged to participate in appropriate development skills training in teaching, research and management. However, for most staff, the current work loads in teaching (including field commitments to undergraduate and postgraduate students and on-campus sessions extending over 12 months of the year), administration, research and in some cases, technology maintenance and development, significantly limit the time available for such opportunities.

### ***Level A: Associate Lecturer***

Level A appointments may be made to people with relevant Honours degrees, masters degrees or other appropriate research or professional qualifications. PhDs are not required at the lower levels, but is usually expected that the Associate Lecturer would enrol of a PhD program and satisfactory progress towards a PhD is a normal expectation. In some instances there may be exceptional teachers for whom extra research qualifications are a secondary consideration. Lecturer A is commonly the commencing position for academic careers for promising young researchers and teachers. Applicants with PhDs but little research and teaching experience would be appointed at the higher levels within this category.

### ***Level B: Lecturer***

A PhD is normally required.

### ***Level C: Senior Lecturer***

A PhD is normally required. There may also be additional relevant professional qualifications.

### ***Level D: Associate Professor***

A PhD is normally required. There usually should also be additional relevant professional qualifications.

### ***Level E: Professor***

A PhD is normally required. There should also be additional relevant professional qualifications, evidence of positive leadership abilities, and national and international recognition in research.

## ***Teaching Contributions***

Most teaching follows the lecture-plus-tutorial/laboratory practical mode together with field work. Lecture components of many units are offered in a flexible mode with audio or video tapes available and units or components of units on the web (access restricted to enrolled students). General information about Geology and Geophysics is also accessible on the web. While advantage is being taken of new teaching methodologies including interactive computer-based exercises, CD-ROM presentations and the internet, EPS offerings are still

very much "hands-on" and will always require relatively intensive staff/student interaction in the laboratory and field. A substantial number of the undergraduate units are offered externally but with most the laboratory and/or fieldwork requirements necessitate the students attendance at "on-campus-session" (commonly taught on weekends) and field camps (commonly taught during semester breaks). Teaching these offerings requires a similar range of teaching methods but the staff interaction is still indispensable where a practical component is involved.

Shared unit of study responsibility and team-teaching are characteristic patterns in our Department. Unit responsibility is determined in part by both student and staff distribution within subject areas. Some staff, independent of level, may contribute to a large range of units of study; some may be responsible for or participate in a small range of courses over any 5-year period because of these factors. Some staff may not be required or have the opportunity to be solely responsible for a whole unit.

Postgraduate enrolments in Geology have been low nationally for some time and this is in part due to the preference of the minerals exploration industry for honours graduates. The Department has maintained good honours year numbers with excellent outcomes. It is therefore not easy to attract PhD students and it cannot be expected that every staff member will have numerous postgraduate students. The trend, encouraged by the Australian Research Council, is that (at least at the PhD level) the projects of postgraduate students should be integrated with or relevant to the supervisor's research. It is expected that the supervisor will exercise an active role in postgraduate training in research methodology as well as in specific skills and knowledge. Supervisors in EPS would normally be expected to maintain a high degree of contact (at least 2 hours per week, yearly average) with a full-time research postgraduate student. This would include close knowledge and supervision of all facets of the project (e.g. field, laboratory studies). Supervision is generally shared with another staff member or external supervisor.

The Department offers MSc coursework programs that can be delivered by distance teaching (with on-campus and field practical components). The development of such courses could become an important teaching strand in the area.

Teaching involves both a base level of traditional knowledge and a component of rapidly evolving concepts and their applications that are relevant to all subject areas. EPS staff are expected to be able to accommodate both of these at 100-level across the disciplines and to higher levels within appropriate sub-discipline strands. This would be evident by continual evaluation of units to incorporate new developments. In addition it is expected that unit design should also be updated progressively, where applicable.

This may not be applicable to some types of fieldwork or laboratory activities and the emphasis the disciplines place on innovative curriculum development and course and unit design is variable.

#### *Level A: Associate Lecturer*

Level A staff normally contribute to all undergraduate levels, with a small number of lectures and a significant load of laboratory, tutorial and field sessions. Those with a PhD generally participate in more lecturing and in teaching development, either by developing units or by thematic applications to teaching (e.g. introduction of multi-media, GIS, etc). They are actively encouraged to participate in development courses by time management of their teaching loads in the Geology Area. They may also supervise Honours students with the assistance of more experienced staff and may undertake Postgraduate supervision relevant to their research interests if suitably qualified and willing to do so, again with the assistance of more experienced staff as associate supervisors.

#### *Level B: Lecturer*

Level B staff should have the ability to be competent teachers of most aspects of 100-level Geology and Geophysics, a broad range at 200-level and at a very sound level in their area(s) of expertise at 300-level in lectures, laboratories, field and tutorial sessions. The career patterns of geologists means that there is a large pool of excellent applicants with

many years of research experience but little career opportunity for teaching experience. However, there must be some evidence of commitment to teaching; and some participation in some undergraduate units or advising of postgraduates may be expected if they have been in a university (or equivalent) research environment.

Lecturers are expected to contribute substantially to unit development and continuing preparation of teaching materials. This will commonly be in cooperation with other staff because of the team teaching mode of many geology units. Lecturers may be responsible for unit presentation and coordination at any level. They would be expected to supervise Honours students and be able to supervise postgraduate students in their field of interest if the clientele are available.

#### *Level C: Senior Lecturer*

For promotion to Senior Lecturer, it would be expected there would be evidence of the ability to accept significant responsibility at any level for whole units (or appropriate segments of units in a team teaching environment) and a demonstrated ability to restructure and design courses or segments thereof in an innovative way. Some leadership in teaching methods and innovation should be demonstrable. Senior Lecturers may be responsible for several honours students and postgraduate students at any given time if the clientele were available. They are also expected to actively promote the discipline to attract undergraduate and postgraduate students and to show evidence of promoting cooperative teaching within the SUCOGG environment. Conscientiousness in providing a good role model in behaviour must be evident, such as punctuality for teaching scheduled sessions and safety awareness (especially in the field). Peer review of teaching quality by colleagues sitting in on teaching sessions would be helpful evidence of teaching skills, in addition to audited student assessments (e.g. TEDS).

For appointment to Senior Lecturer, applicants may be expected to have a demonstrated track record of teaching over several years with qualifications coinciding with the expectations outlined for promotion to Senior Lecturer if they have been employed as a lecturer or similar at another Tertiary Institution. However, the current career pattern of many geologists and geophysicists aspiring to academic posts commonly involves postdoctoral fellowships for 10 years or more with limited opportunities for teaching but resulting in excellent research and research leadership/administration qualifications. Therefore appointments to Senior Lecturer may be made with limited teaching experience, but there should be convincing evidence of commitment to teaching, the ability to deliver effective lectures, tutorials, laboratory classes and, commonly, field teaching if applicants have been in a university environment or have had such possibilities. Evidence of commitment may be in the form of significant contributions to teaching programs, delivery of short courses (perhaps on a regular basis) or demonstrated effective supervision of postgraduate or junior postdoctoral students.

#### *Level D: Associate Professor*

Associate Professors would be expected to have made a substantial, effective and sustained contribution to teaching (possibly at all levels if reasonable opportunity has been available). Their level of performance should be excellent (i.e. exceeding satisfactory and the level expected for Senior Lecturer) as judged by peers, students and, if applicable, by external recognition. They should generally have:

- a demonstrated high degree of expertise in their subject area
- a demonstrated interest in and commitment to teaching
- developed substantial teaching materials
- demonstrated the ability to successfully implement positive innovative teaching programs and/or materials
- demonstrated the ability to introduce changes in teaching in keeping with advances in knowledge and concepts in the discipline (e.g. the importance of constructing interdisciplinary programs)
- actively promoted cooperative teaching within the SUCOGG environment
- a demonstrated willingness and ability to disseminate knowledge within the wider community
- demonstrated leadership in substantial aspects of teaching in the discipline

- a trace record of successful attraction and supervision of honours and postgraduate students.

*Level E: Professor*

In addition to all the qualities required of Associate Professor, Professors should demonstrate leadership in curriculum development and reform where applicable and show evidence of successful innovations requiring vision.

## **Scholarship and research**

For most research projects the final output will normally be papers for publication in refereed journals, but output could validly include any or all of the following:

- Short notes in research journals
- Books, monographs
- Review articles
- Book chapters: these have similar status to journal papers when refereed
- Conference presentations (usually with published abstracts)
- Reports for governmental bodies, industry and other agencies.

It is not considered that length of publication has any necessary correlation with merit. Multiple authorship has increasingly become a common form of publication and commonly only reviews are sole-authored. For promotion, a lecturer should be the senior (or leading) author of several papers. Fully refereed publications in reputable journals/monographs in Australia and overseas are the accepted vehicle of communicated research and scholarships (i.e. peer review is of paramount importance). Conventional citation indices should be used with caution.

Other evidence of recognition of research success and scholarship may be:

- success in research funding from external, peer-reviewed sources
- attraction of research funding through collaborative industry projects
- funding for significant equipment or infrastructure
- setting up a successful laboratory/facility that attracts researchers
- attraction of visitors to the research environment for short and extended (>4 weeks) periods
- invitations to participate in restricted workshops, conferences
- invitations to review books, referee journal papers, examine theses
- invitations to present papers at national and international conferences
- membership of editorial boards of international journals
- editors of special volumes
- membership of international committees, commissions and similar
- organising conferences/workshops
- invitations to contribute to benchmark books or volumes

*Level A: Associate Lecturer*

Associate lecturers at the lower levels should generally be starting to undertake research as part of a PhD program, although some may be concentrating more on teaching activities by choice, in which case, they should have an appropriate research program mentored by a more senior staff member. Normally, completion of a PhD would be expected after a reasonable candidature time. Publication of results sequentially through the PhD program and of final results within a reasonable timescale afterwards is expected. Publications should be in refereed journals of international standing. Evidence of seeking research funding by writing proposals would be a normal expectation by the end of the candidature. Those with a PhD are expected to seek research funding by writing proposals, usually for internal schemes, but are encouraged to seek external funds after some pilot studies and successful publications.

#### *Level B: Lecturer*

It would be reasonable to expect that a lecturer would have produced annually at least 1 journal paper (or the equivalent); some of these could be spin-offs from the PhD, others the products of subsequent research. There should be evidence of expanding research activities since the PhD. There should be a track record of research funding success appropriate to the requirements for the type of research.

#### *Level C: Senior Lecturer*

Senior Lecturers would normally be expected to have established a sound reputation in their field(s) of expertise, evident through a selection of the recognition criteria detailed above. This would represent significant advances on the research resulting from their PhD. For most research products (at senior lecturer level) the final output would normally be papers published in refereed journals, with the expectation of significant and recognisable impact on the international community in the discipline. These publications would be expected to be mainly in international research journals, monographs, books, conference papers, review articles. If most publications have dual or joint authorship, then it would be expected that, for promotion to senior lecturer, the lecturer should be the senior (or leading) author of several papers. There should be a track record of research funding appropriate to the field, and evidence of appropriate research student interaction.

#### *Level D: Associate Professor*

It is expected that an Associate Professor would have made sustained and substantial contributions to research and the advancement of knowledge in the discipline and have established a significant national and/or international reputation in their field.

The track record of research projects, research supervision and tangible achievements such as publications should reflect their industry and provide clear evidence of the success and significance of their endeavours. A reasonable number of publications should be identifiable as very significant (normally in the international arena) by acceptable criteria such as invitations to present this work in significant meetings, invitations to review the subject area or citations if applicable. Joint authorship may be common, but clear evidence of senior (or leading) authorship is obligatory, especially for the influential publications. There should be no evidence of waning productivity with time.

Associate Professors would commonly receive invitations to be keynote speakers or invited lecturers at professional meetings. It would normally be expected that there would also be a consistently successful record of research grants as Chief Investigator in a competitive, externally peer-reviewed arena. This provides proof of outstanding research leadership, in which the candidate is clearly the major thrust behind the work. Major research consultancies and collaborative research with industry partners may also be evidence of excellence and relevance of research as well as a source of substantial funding.

#### *Level E: Professor*

Professors should have gained high international standing in their research field(s) and there should be evidence that this is being maintained by on-going high quality research programs. Research funding and track record should be outstanding for their appropriate field.

Professors should have evidence of excellent leadership and are likely to be the discipline's research leaders.

### ***Service to the University and Community***

It is common for Earth Scientists to be members of several professional organisations related to their work and experience. They may often take an active role such as office bearers, conference organisers, journal editors etc. Professional organisations of this nature commonly have an international profile and play an important role in disseminating research information, fostering public debate about issues, providing advice and direction for government and industry at all levels, and maintaining essential communication links through the discipline. There is no proscribed relationship between seniority and degree of

involvement because all such work is voluntary and can only be done at the expense of other activities and commitments.

Academic staff may often provide advice and direction to government departments and instrumentalities. This may include membership of panels, curriculum development for secondary schools and HSC examinations. This role may be filled by Associate Lecturers or Lecturers as well as higher level staff. Senior staff may be asked to participate in external appointment or promotions panels or to be on advisory boards for Geological Surveys and other professional organisations. Senior staff with excellent research track records may be invited to join panels of the Australian Research Council. It should be noted that these are also voluntary and no teaching relief or secretarial assistance is given by the University as support to facilitate these activities.

All community relations activities are time-consuming. They are an important part of professional activity within the discipline, but demands are increasing exponentially and demands on senior staff are so great that few individuals can satisfy all requests. Assessment of these activities in an appointment or promotion application is difficult and must be balanced against all the other attributes and achievements of the individual.

However, service within the University is expected, including appropriate involvement in Divisional and University committees and promotion of EPS to potential students. Unlike other disciplines, field research and field supervision of research students plays an important role in the geology discipline, and is very time consuming. This inevitably impacts on time available for other activities. Contributions to field teaching are recognised and valued by the disciplines.

Interaction with industry may vary according to particular fields and individuals. Strong collaborative industry links are a positive factor.

*Level A: Associate Lecturer*

Level A staff would be expected to take an active role in the day to day administration of units, student advising, and Departmental/Divisional and university promotions activities. They would be expected to be active members of some of the appropriate Divisional committees.

*Level B: Lecturer*

Lecturers would normally be expected to successfully handle several (two or three) middle range administrative roles and to take a very active part in the student advising and enrolment process and University promotion.

*Level C: Senior Lecturer*

Senior lecturers are expected to have three or four more important and sustained functions including representation on senior Divisional and University committees. They would commonly chair such groups. Departmental, Divisional and University promotional activities are expected.

Level C staff may be expected to supervise and/or act as mentors for junior staff in both teaching and research.

*Level D: Associate Professor*

Associate Professors would cover a similar range of committee activities as level C staff and would often chair such groups. Heads of Area and School are automatically on several administrative bodies and make a commensurately larger contribution to Departmental and University administration consistent with their positions. Departmental, Divisional and University promotional activities are expected. Staff in these positions may have supervisory responsibility for other academic and general staff.

*Level E: Professor*

Professors are expected to take on a wide range of Departmental, Divisional and University administrative responsibility, typically in leadership roles. Professorial staff should also be

active in forging and promoting linkages between the University and the community in the broad sense (including industry). Departmental, Divisional and University promotional activities are expected.