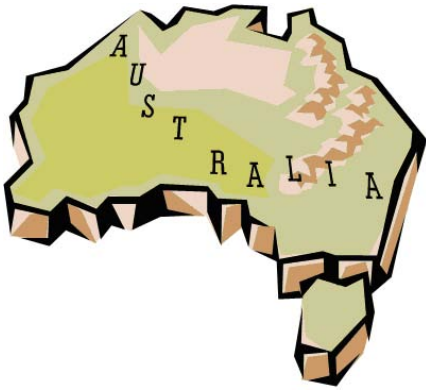
The University of Sydney

School of Geosciences

GEOS 2113 Making the Australian landscape



Semester 1: 1 March–4 June 2010
Lecturer: Stephen Gale

Course content and aims

The arid, ancient and often inhospitable Australian landscape is the product of 4000 million years of complex evolution. The continent possesses the oldest materials so far discovered on Earth and supports landforms whose origins can be traced back almost a thousand million years. Yet its aridity and its vegetation are of relatively recent origin, and its climates and environments have taken on a recognisably modern form only in the last 10 000 years. Even more recent have been the impacts of human activity. Yet both the pre-European and the European occupants have utterly transformed the environment, making the changes of the last millennia perhaps the most dramatic that the Australian landscape has experienced.

Course structure

The course consists of 24 lectures and 9 practical classes. The topics covered in each lecture and practical are outlined in the timetable below.

Reading

No single book is available that covers all parts of the course. Consequently, a range of recommended readings is listed below. Nevertheless, the following texts provide useful supplementary material:

Flannery, T.F. 1994. *The future eaters: an ecological history of the Australasian lands and people.* Reed, Sydney, 423 pp.

Twidale, C.R. and Campbell, E.M. 2005. *Australian landforms: understanding a low, flat, arid and old landscape*. Rosenberg, Dural, 336 pp.

White, M.E. 2000. *Running down: water in a changing land*. Kangaroo Press, Sydney, 276 pp.

Young, A.R.M. 2000. *Environmental change in Australia since 1788.* Oxford University Press, Melbourne, 2nd ed., 243 pp.

Note that the references provide only an introduction to the main topics covered in the course. You should read as widely as possible around these subjects, particularly when you find your interest or curiosity aroused. The books on the list all contain references to guide your reading in relation to particular themes. If you require further guidance on specific topics, either see me or consult *Geobase* or *GeoRef*, which summarise and index much of the enormous volume of material published on the Australian landscape each year.

A copy of every item on the reading list is available either on-line or on reserve in the SciTech Library.

Lectures

Lectures will be held at 1105 h on Mondays and Wednesdays in Madsen Classroom 331.

Lecture 1. Introduction to the course

The surface of the Earth is constantly changing, with the rate of change varying across both space and time. The primary energy for these changes comes first from the Earth's internal heat engine, fuelled by radioactivity, and secondly from the Sun. Endogenetic processes spew new material out onto the Earth's surface, propel the convection currents in the mantle that control the movement of the lithospheric plates, and break and buckle the Earth's crust. Exogenetic processes drive the atmospheric and hydrological systems and provide energy for biophysical processes, controlling the processes of weathering, erosion, transport and deposition.

Lecture 2. Australia: the old and quiet continent?

Australia is the most ancient of the continents. Not only does the country contain the oldest crustal materials so far discovered, but it is made up of a higher proportion of ancient terrain than any other continent. Australia is also one of the Gondwana continents. For over 1000 million years it formed part of the great southland continental agglomeration, breaking away and drifting north to its present location only in the last 50 million years or so.

The low relief and tectonically-stable nature of Australia have meant that geomorphic processes have operated only slowly across the continent. As a result, elements of the physical landscape have been preserved here for longer than almost anywhere else on Earth and recent episodes of Earth moulding have had only minor impact on the nation's landforms. Australia is truly the old and quiet continent.

Gale, S.J. 1992. Long-term landscape evolution in Australia. *Earth Surface Processes and Landforms* 17, 323–343.

Johnson, D.P. 2004. *The geology of Australia*. Cambridge University Press, Cambridge, 276 pp.

Ollier, C.D. 1986. Early landform evolution. In Jeans, D.N. (ed.) *Australia — a geography. Volume one. The natural environment.* Sydney University Press, Sydney, 2nd ed., 97–116.

Lectures 3–10. Landforms and processes

The tectonic processes that give rise to landforms by and large result in positive relief. This relief is worked upon by a variety of exogenetically-driven processes that act to wear it down and to carve the Earth's surface into the array of landscapes that we see around us. The Earth's landscape at any instant of time thus represents the net effect of exogenetic processes and endogenetic processes.

The geomorphic and sedimentological consequences of these exogenetic processes are considered in the context of fluvial environments (Lectures 3–5), hot desert environments (Lectures 6–7) and karst environments (Lectures 8–10).

Lectures 3–5. Rivers and landforms

Evidence of river activity can be found on all parts of Australia's landmass, even in the most arid terrain. Rivers are the continent's greatest transporters of debris and globally are the most significant agents operating to mould the landscape. A knowledge of fluvial landforms is thus critical to any understanding of Australia's physical environment.

Bridge, J.S. 2003. *Rivers and floodplains: forms, processes and sedimentary record*. Blackwell, Oxford, 141–211.

Bloom, A.L. 1998. *Geomorphology: a systematic analysis of late Cenozoic landforms.* Prentice Hall, Upper Saddle River, 3rd ed., 206–229, 240–243.

Pickup, G. 1986. Fluvial landforms. In Jeans, D.N. (ed.) *Australia — a geography. Volume one. The natural environment.* Sydney University Press, Sydney, 2nd ed., 148–179.

Lectures 6–7. Hot deserts

The Australian deserts are continental in scale, extending for more than 2000 km from east to west. Collectively, they form the largest arid region in the Southern Hemisphere, covering 3.5 million km^2 of desert uplands, salt lakes, stony desert, sand plain and dune fields. If the semi-arid zone is included, the area of Australia's desert region exceeds 5 million km^2, 70% of the total Australian land mass. The arid core of the continent centres on Lake Eyre, a vast salt lake of almost 9500 km^2, where annual rainfall averages about 100 mm. However, one of the distinctive features of Australian deserts is their extreme rainfall variability: 20–40% more variable than regions of comparable rainfall elsewhere.

Bloom, A.L. 1998. *Geomorphology: a systematic analysis of late Cenozoic landforms.* Prentice Hall, Upper Saddle River, 3rd ed., 277–285, 288–307.

Hesse, P.P., Luly, J.G. and Magee, J.W. 2005. The beating heart: environmental history of Australia's deserts. In Smith, M.A. and Hesse, P.P. (eds) *23°S: archaeology and environmental history of the southern deserts*. National Museum of Australia Press, Canberra, 56–72.

Lectures 8–10. Karst

Despite the restriction of karst to areas of soluble rock, karst landscapes are widespread in Australia, extending from the tropical humid karst of Chillagoe to the arid and semi-arid karsts of the Nullarbor and the Barkly, and from the temperate karsts of southeast Australia to the subalpine karst of Tasmania. Karst supports some of Australia's most distinctive landscapes, and has a unique potential for the preservation of information on landscape evolution and environmental change.

Bloom, A.L. 1998. *Geomorphology: a systematic analysis of late Cenozoic landforms.* Prentice Hall, Upper Saddle River, 3rd ed., 147–168.

Jennings, J.N. 1985. *Karst geomorphology.* Blackwell, Oxford, 2nd ed., 293 pp.

Lectures 11–13. The Cenozoic: descent into the ice age

Prior to 40 million years ago, the Earth was mainly warmer and wetter than it is at present. Rainfall tended to be distributed evenly throughout the year, and evergreen and warm deciduous forests covered most of the globe. Many types of vegetation, climate and landscape known today were almost entirely absent because of the lack of seasonality and aridity. Thus, grasslands and deserts were rare, boreal forests and tundra were almost non-existent, and glaciers and sea-ice were absent. Even Antarctica was ice free. Since that time, the world has descended into an ice age. Global temperatures have fallen, high altitudes and high latitudes have been periodically glaciated, there have been large changes in sea level, and the Earth has experienced the relatively rapid migration, speciation and extinction of plants and animals.

White, M.E. 1994. *After the greening the browning of Australia*. Kangaroo Press, Sydney, 288 pp.

Lectures 14–17. The Quaternary ice age

Global cooling began around 40 million years ago, transforming a moist tropical world to an ice-bound Earth. The polar conditions are occasionally interrupted by short, warm interglacials similar to the one in which we currently live. Such episodes last no more than a few thousand years, however.

The frigid conditions of the present ice age have had little direct impact on mainland Australia, although the landscape of Tasmania has been transformed by successive episodes of glaciation. Nevertheless, the nation's aridity, the rises and falls in sea level that have produced Australia's coastal landforms, and even the *Eucalyptus*-dominated vegetation cover of the continent are all a product of ice age climates.

Bowler, J.M. 1986. Quaternary landform evolution. In Jeans, D.N. (ed.) *Australia — a geography. Volume one. The natural environment.* Sydney University Press, Sydney, 2nd ed., 117–147.

Wasson, R.J. and Clark, R.L. 1987. The Quaternary in Australia — past, present and future. *Bureau of Mineral Resources, Geology and Geophysics Report* 282, 29–34.

White, M.E. 1994. *After the greening the browning of Australia*. Kangaroo Press, Sydney, 288 pp.

Lecture 18. The Holocene

The brief interlude of warmth in which we live is merely the latest of a series of short interglacials that have interrupted the Cenozoic ice age. An understanding of the environmental shifts that have occurred during this time is essential not only for a comprehension of human impact on the landscape, but also to allow us to predict the direction of environmental change in the future.

Roberts, N. 1998. *The Holocene an environmental history.* Blackwell, Oxford, 2nd ed., 316 pp.

Lecture 19. Sub-millennial scale environmental fluctuations

The general view of the Holocene is one of environmental stability, but even in the last millennium, there have been distinct variations in climate. The most well-known of these are the so-called Mediaeval Warm Period and Little Ice Age.

Grove, J.M. 2004. *Little ice ages: ancient and modern volumes I and II.* Routledge, London, 718 pp.

Hughes, M.K. and Diaz, H.F. 1994. Was there a 'Medieval Warm Period', and if so, where and when? *Climatic Change* 26, 109–142.

Lectures 20–21. Pre-European human impact on the Australian environment

The conventional view of Palaeolithic peoples is that their numbers were too small and their technologies too primitive for them to have had any impact on the natural environment. Yet there is evidence that Aboriginal land use may have massively and irrevocably transformed the Australian landscape.

Flannery, T.F. 1994. *The future eaters: an ecological history of the Australasian lands and people.* Reed, Sydney, 423 pp.

Kohen, J.L. 1995. *Aboriginal environmental impacts.* University of New South Wales Press, Sydney, 160 pp.

Lectures 22–24. Early colonial impact on the Australian environment

With the arrival of European technologies and land use practices, the Australian environment, much of which was highly sensitive to disturbance, was subjected to massive environmental shock. There is strong evidence that the impacts that occurred in the first years of contact were of such magnitude that they have governed environmental response ever since. We shall consider this question within the context of three aspects of environmental modification: soil erosion, vegetational change and environmental pollution.

Gale, S.J. 2003. Making the European landscape: early contact environmental impact in Australia. In *Geography's new frontiers.* Geographical Society of New South Wales Conference Papers 17, 7–16.

Rolls, E.C. 1999. Land of grass: the loss of Australia's grasslands. *Australian Geographical Studies* 37, 197–213.

Smol, J.P. 2002. *Pollution of lakes and rivers a paleoenvironmental perspective.* Arnold, London, 280 pp.

Practicals

With the exception of week 4 (24 March), all practicals will be held on Wednesdays in Madsen Classroom 331 at 1305–1655 h. Week 4's practical will involve the field investigation of fluvial sediments. You should meet outside Bondi Icebergs Club (at the southern end of Bondi Beach) at 1330 h.

Practicals will begin in week 2. There will be no practicals in weeks 6, 9 and 12. However, assignments are due on each of these days.

Week	Practical
2	1. Drainage patterns on the New England Tablelands
3–5	2. Fluvial sediments of the Sydney Basin
7–8	3. Boulder Bay—tsunamis and saprolites
10–11	4. Tocal Homestead Lagoon—sediment geochemistry and environmental reconstruction
13	5. Soil erosion and human impact

The practicals will involve the analysis and interpretation of field and laboratory data. Typically, about an hour will be spent introducing the exercise and discussing procedures. The remaining time will be spent analysing and interpreting the data. Each exercise will be submitted for assessment. Exercises 2–4 should be posted in the boxes outside room 348 (the Geosciences Office) in the Madsen Building. Exercises 1 and 5 should be handed in at the end of the practical class. Marked assignments may be collected from the filing cabinets inside room 348. Note that it is School policy that a penalty of 5% will be incurred for each day or part of a day that an assignment is overdue. The deadlines for submission are as follows:

Practical 1	1700 h, Wednesday 10 March
Practical 2	1700 h, Wednesday 14 April
Practical 3	1700 h, Wednesday 5 May
Practical 4	1700 h, Wednesday 26 May
Practical 5	1700 h, Wednesday 2 June

Your practical reports should show how the field and laboratory data have been analysed. They should contain your interpretation of the data, a discussion of the results and your application of the findings to test a particular hypothesis or to solve a problem. The reports should attempt to place your results in the context of the wider literature on the subject. They should not, however, contain exhaustive details of laboratory and field procedures; reference to procedures written up elsewhere should suffice.

Assessment

Practical 1	5%
Practical 2	15%
Practical 3	10%
Practical 4	15%
Practical 5	5%
Examination	50%

Academic honesty and plagiarism

Plagiarism will not be accepted under any circumstances. There are penalties for academic dishonesty and universities take this issue very seriously. It is University policy that all submitted assignments should be

accompanied by a signed and dated cover sheet declaring that your work meets the University's standards of Academic Honesty. The University's policy regarding academic plagiarism may be found online at http://www.usyd.edu.au/senate/policies/Plagiarism.pdf. If you are unclear about any aspect of this policy, please discuss this either with me or with the second-year coordinator. A copy of the cover sheet is attached to the end of this handout.

Teaching staff

The lecturer for this course is Dr Stephen Gale. His office is in room 441 on the top floor of the Madsen Building. He may be contacted by telephone on 02-9351-3308 (or 13308 using the internal system) or by e-mail on stephen.gale@sydney.edu.au.

The second-year coordinator is Associate Professor Gavin Birch. His office is in room 462 on the top floor of the Madsen Building. He may be contacted by telephone on 02-9351-2921 (or 12921 using the internal system) or by e-mail on g.birch@usyd.edu.au.

The tutor for this course is April Crawford-Smith. She may be contacted by e-mail on acra2071@uni.sydney.edu.au

World Wide Web

Links to material related to the GEOS 2113 *Making the Australian landscape* course may be obtained via http://www.geosci.usyd.edu.au/units_of_study/us_geos2113.shtml.

Examination

An examination will be held in the examination period at the end of First Semester. The examination will be two hours in length. You will be required to write essay-length answers to three questions. You will be given a choice of at least five questions. Each question will be worth 33% of the total mark for the course. Examples of the sorts of questions that you might face are shown below.

> 1. 'When we were primitive beings, which was essentially until we developed modern technology, we had little capacity to clash with the environment except to get mauled by a bear or drown.' (Cargo and Mallory, 1977, 4–5). How well does this assessment fit the picture of Aboriginal impact on the Australian environment?
>
> 2. Explain how stable isotopes have been used to reconstruct the environmental history of the Cenozoic.
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> 3. You are about to begin Honours research on the impact of human activity on the Australian biophysical environment. What problem would you study and how would you proceed?

Stephen Gale
February 2010
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The University of Sydney

School of Geosciences

Individual Assignment Cover Sheet

Surname:
First name:
Student number:
Unit of Study name/code:
Assignment name/number:
Due date:

Plagiarism for the purpose of this compliance statement (which applies to students enrolled in course work degrees) means presenting another person's work as one's own work by presenting, copying or reproducing it without acknowledgement of the source. The University's policy regarding academic plagiarism can be found online at http://www.usyd.edu.au/senate/policies/Plagiarism.pdf.

Legitimate co-operation can be defined as any constructive educational and intellectual practice that aims to facilitate optimal learning outcomes through interaction between students. Typical examples of these practices may include:

- the researching and writing of joint projects/written works/tutorial papers;
- discussion of general themes and concepts;
- interpretation of assessment criteria;
- informal study/discussion groups;
- strengthening and development of academic writing skills through peer assistance;

Legitimate co-operation is based on the principle that producing the work remains the independent responsibility of the student (or group of students where a joint project is undertaken), while recognising the educational value of interaction between students.

Academic Honesty Declaration

Please confirm that your assignment meets the academic honesty requirements by ticking each box and signing below:

☐ This assessment is my own work
☐ I understand the requirements for academic honesty
☐ I am aware of plagiarism and its penalties
☐ I have not re-used previously submitted material in this assignment
☐ I have not engaged someone else to complete this assignment
☐ I have retained a duplicate hard copy of this assignment

Student Signature: _____ Date: _____