Director's Welcome
Andrew Roberts describes recent changes

Voyage to Antarctica
Kelly Strzepek talks about taking part in science experiments in the great Southern Ocean

A Eureka Moment
Researchers are pushing the boundaries of scientific knowledge

Alumni Profile
Chris Pigram, Chief Executive Officer of Geoscience Australia loves a challenge

Working in the highlands of PNG
Oleg Koudashev’s PhD project

Awards
Learn more about our Rock stars

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Editing: Mary Anne King and Andrew Roberts
Contact Mary Anne King to submit content.
NEW BUILDING SHOWCASES EARTH SCIENCES

A new energy-efficient building was ready for the start of the academic year. Jaeger 8 was designed with an eye on sustainability, natural light and low energy and water consumption. It is decorated with stones and patterns reproducing natural features such as the facade in red travertine, the stairs covered with tuff, gabbro tiles in the foyer and leaf motifs replicating the iconic Glossopterus fern. Precious mineral and rock collections and the famous William Smith “Map that changed the World” are on display. Varieties of travertine, marble and igneous rocks were used internally and externally and can be used as a teaching tool for students studying earth sciences. The research and teaching environments within the building have been designed to be flexible and adaptable.

The building includes numerous sustainable design principles. Rainwater collection is used for irrigation, toilet flushing and to provide cool air to the building during summer. Double glazing to windows and doors, external sun shading and an innovative mechanical air handling system ensure the building achieves excellence in energy efficiency.

The building is open to the public during normal business hours.

From the Director

Welcome to our first issue of Unearthed, the new RSES newsletter. We will celebrate the 40th birthday of RSES next year, and are seeking to reconnect with you in advance of these festivities. Some big changes have happened in recent years. The former Department of Earth and Marine Science (DEMS) merged with RSES four years ago. We now have a new building and colleagues and students have almost completed the relocation from the D.A. Brown Building into the Jaeger complex on Mills Road. Much of our undergraduate teaching now occurs in the new facilities, which has brought a new dynamic to this side of campus.

While much may have changed since many readers last visited campus, some things remain the same. The exceptional quality of research at RSES continues. For example, Professor Patrick De Deckker was recently inducted as a Fellow of the Australian Academy of Science and Professor Hugh O’Neill has been elected as a Fellow of the Royal Society of London. Hugh continues a long and distinguished tradition by being the 9th FRS from RSES. We hope that you will enjoy reading about our recent news and that you will visit us again soon — perhaps for our 40th birthday celebrations in 2013.

Best wishes,
Andrew Roberts
Director, RSES
National Youth Science Forum

In January some of Australia’s brightest Year 12 students had the opportunity to see what’s happening in earth sciences. Students discovered that the school included scientists from many disciplines: biologists, chemists and geochemists looking at corals, climate change and the mysterious ecosystems that inhabited the Earth’s earliest oceans; physicists, palaeontologists, geologists, mathematicians and geomorphologists looking at erosion, glaciers, tectonics, lava flows, ocean circulation and mantle convection.

The students participated in lots of experiments and saw the famous mass spectrometer SHRIMP which helps scientists investigate mineral reactions from the deep earth to interstellar dust.

Summer research program

Six students from Australian and New Zealand universities were given the opportunity to participate in an 8-week individual research project. Morgan Williams reflects on his experience:

My summer involved investigation of high temperature opals, including their synthesis and subsequent analysis of water content and speciation. From sample preparation and experiments through to analysis, I was introduced to a variety of instruments and techniques that I’m certain to utilise further in the future. Personally, the experience also enabled me to identify potential honours projects, and has given me a greater sense of direction for my continuing study. The summer was packed with social events, and I enjoyed my free hours with a diverse group of switched-on students from across the country and overseas. For those with an interest in the earth sciences, the ANU’s RSES provides the opportunity to interact with a world-class group of researchers. The facilities provided are cutting-edge, and the training you receive enables you to end your summer having gained a particularly useful set of skills.

For more details about the Summer Research Program visit anu.edu.au/sas/scholarships/srs/

South Africa and Namibia field trip

A combined group of undergraduates, honours and PhD students recently participated in an Economic Geology field trip to South Africa and Namibia led by Dr John Mavrogenes. The students visited the Vredefort Dome, possibly the world’s largest impact structure, explored world-class outcrops including shatter cones and toured several mines. They also participated in a variety of cultural activities.

OnCirculation.com

On Circulation is about science and the lives of researchers. We study the circulation of the solid earth, the oceans, and the universe beyond, from the molecular level to the scale of the solar system. We welcome comment, encourage discussion and hope that you enjoy the subject matter, and indeed the personalities, that make our institute and our field so exciting and stimulating.

Check out the latest: oncirculation.com

Outstanding students awarded University Medals

Last year’s Honours graduates have really put out the challenge to 2012 students. There were four students who received the prestigious ANU University Medal: Rowan Romeyn, Marita Smith, Xuerong Qin and Callum Shakespeare. Congratulations!

Seismometers in schools

Check out the new Facebook page about the Australian Seismometers in Schools, a four year outreach program in which RSES is involved. We have recently installed the first instruments in schools and will eventually place 40 seismometers in high schools across Australia.

Hon. Senator Chris Evans, Minister for Tertiary Education, Skills, Science and Research will officially launch the program at the end of May.

facebook.com/ausisnetwork
In January I was given the incredible opportunity to take part in the major marine science campaign of the *Aurora Australis* for the 2011/2012 season. This unique voyage combined a varied science campaign with one of a more historical nature; the centenary celebration of Douglas Mawson’s landing at Commonwealth Bay, Antarctica. Historically, Commonwealth Bay has been the best place to land due to the katabatic winds that roar down the slopes, keeping the bay permanently ice free. Oceanographically speaking this is significant as the water in the ice free zone is very dense (due to salt exclusion during ice formation), and therefore sinks into the deep ocean forming part of the global overturning circulation that is so important to moderating Earth’s climate.

As we traversed the Southern Ocean toward this historical destination we sampled for two particular zooplankton; the pteropod and the foraminifer. Both organisms build calcium carbonate shells that are sensitive to changes in pH and can therefore be used to monitor the impacts of ocean acidification. Closer to the continent our early landing attempt was thwarted due to the recent activity of a giant iceberg that originated from the Ross Sea Ice Shelf several decades ago. B9B, as the iceberg is affectionately known, collided with the Mertz Glacier Tongue, which then calved from the mainland and blocked the entrance to Commonwealth Bay. This event has resulted in marked differences to the physical and biological oceanography of the region. Where preliminary measurements taken on the voyage indicate that the formation of dense bottom water has slowed, measures of productivity indicate that the biological drawdown of CO$_2$ in the region is higher than previously recorded.

All this was achieved before we even began the major campaign to sample one of the ocean’s superhighways. The ocean is criss-crossed with transects like the I9 that runs north-south between Fremantle and Antarctica. These transects are sampled in a concerted effort to better understand the processes and structure of our global oceans. By sampling through the water column, sometimes down to almost 6000 metres, CSIRO scientists will be able to determine the velocity and position of some of the deep currents of the great Southern Ocean. Furthermore, carbonate chemists worked around the clock to ensure that the oceanic carbon system could be adequately covered, and then compared with the measurements that were taken when the I9 was last sampled seven years ago. Repeat surveys such as this are vital for monitoring how our oceans are responding to current climate change. Due to the sheer scale of the operation they foster collaboration between institutes, promote the pursuit of scientific knowledge, and when you are really lucky, allow you to play with penguins for a few days.

Finding a new Earth: holy grail of astronomy

Determining the habitability of rocky, Earth-like planets in the universe will be crucial for us as a species, according to planetary scientist, Dr Charley Lineweaver and fellow researcher, PhD student Aditya Chopra. Read about this latest published research.

Read about this latest research online in the *Annual Review of Earth and Planetary Sciences*.
DISCOVERING DOLOMITE – A EUREKA MOMENT

Dr Bradley Opdyke

Whenever Earth Scientists can’t figure something out, when established data don’t fit into the modern context, it becomes a ‘problem’.

For over 100 years Earth Scientists have observed a significant amount of the mineral dolomite (calcium magnesium carbonate) associated with limestone deposits in the rock record (in other words, in any limestones over a few thousand years in age). This became known as the ‘Dolomite problem’ and in spite of many efforts to locate significant amounts of dolomite in modern environments, what was found was obscure and insignificant, so the ‘problem’ of how dolomite forms remained.

A team of scientists lead by Dr. Bradley Opdyke was investigating how some of the organisms that are made of a metastable or soluble mineral called high magnesium calcite would handle the global changes in the surface ocean associated with ‘ocean acidification’ or a lowering of the surface ocean pH as atmospheric carbon dioxide concentrations rise. These organisms, called crustose coralline algae, are considered a coal mine canary for this type of environmental change. Merinda Nash, a Masters student within the group, along with Dr. Uli Troitzsch used the well known technique of x-ray diffraction to investigate just exactly what these coralline algae were made of when the ‘eureka’ moment came. Nash and Troitzsch came to the conclusion that these organisms were depositing dolomite within high magnesium calcite cell structures. Further investigation by the duo on the scanning electron microscope confirmed the presence of dolomite and yielded another surprise, magnesite (magnesium carbonate) which also had never been found before in abundance associated with a living organism within the cells they were investigating.

These results, just published in the international journal Biogeosciences, go a long way toward solving the long standing ‘dolomite problem’. Read the paper

Some recent research highlights

Tropical ocean driver of global climatic change
Professor Patrick De Deckker and colleagues from the Leibniz Institute for Baltic Sea Research and the Bjerknes Centre for Climate Research in Norway reported their study in the leading journal Nature Geoscience.

Discovery shakes beliefs of Earth to the core
Professors Ian Campbell and Hugh O’Neill have challenged the belief that the Earth has the same chemical make-up of the Sun.
Read the article in Nature

From magma to mud to magma
Tamworth is famous as the home of Australian country music. But 350 million years ago, some hardcore rock ‘n’ roll was also happening. PhD student Heejin Jeon said 350 million years ago, while much of the world was geologically stable, the country capital was all shook up.
Read the article in ScienceDirect

Looking inside the Earth
Defects found in rocks below the Earth’s surface have a major impact on the transmission of seismic waves. Professor Ian Jackson, said the team’s research allows us to better understand the way seismic waves travel through the mantle deep below the Earth’s surface.
Read the article in Science
One of the benefits of being a scientist is that sometimes you get to discover new things and if you’re lucky enough, you may even be able to get them named after you. RSES alumnus Chris Pigram, who is also the current Chief Executive Officer of Geoscience Australia is lucky enough to have done both. “I’ve had both a fossil and a cicada named after me,” Pigram says. “I found the fossil in some field work I was doing and it was named Linoproductus Pigrami.”

“The cicada is a little different. In some work we did studying the geological history of the island of New Guinea we helped some scientists who were having trouble figuring out how different cicada species came to the island. This resulted in the scientists kindly naming a number of cicada species after geologists involved in the project.” After the excitement of having both a fossil and a cicada named after him, Pigram now places his energy into putting his mark on Government policy and practice.

“I’ve worked in Geoscience Australia for many years now,” he says. “About ten years into working here I was provided with the opportunity to do a PhD at the ANU looking at sea level curves in the Miocene period. It was a fantastic opportunity which allowed me to come back into a leadership role here.” Now, as the CEO of the organisation, Pigram gets to work across a range of Geoscience issues at a top level.

“Geoscience Australia’s role is to be the Government’s advisors on Geoscience matters. We provide information and services for Government across a range of issues from minerals and energy exploration, to natural hazards to ground water management.” “Working in such a diverse portfolio comes with new challenges every day but it is that opportunity to bring science knowledge to an evidence base on national issues that gets me up every day,” Pigram concludes.
Dr Andrew Berry has re-joined the experimental petrology group at RSES after six years as a lecturer at the Royal School of Mines, Imperial College London. His field of research is high temperature geochemistry and mineralogy with a focus on melts and fluids.

Penny King

After nearly twenty years in North America (USA and Canada), Dr Penny King is returning to ANU. She is a mineralogist and spectroscopist interested in the evolution of planetary interiors and surfaces.

In February I started my PhD in the Structure and Tectonics Group under the supervision of Dr Marnie Forster and Dr Malcolm Roberts (Marengo Mining). I am studying the timing of alteration and mineralisation at the Yandera copper-molybdenum-gold-silver porphyry located in the highlands of Papua New Guinea. The deposit is owned by Marengo Mining which is funding this project. I visited the exploration camp at Yandera in November 2011 to gain an understanding of the alteration and mineralisation styles.

The project will use argon geochronology to date potassium-bearing minerals such as hornblende, biotite, and feldspars. Yandera porphyry deposit has a complex pattern of intrusions, alteration and mineralisation. The relations between the alteration/mineralisation and igneous intrusions have not been definitively established. Geochronology would allow these links to be established as well as identifying the extent of thermal events associated with emplacement of igneous bodies and alteration. Results of this project could be used to focus further exploration in the area.

Juan Cruz Larrasoña

I am a researcher based at the Geological Survey of Spain (IGME) and specialise in the application of paleo- and rock-magnetic techniques in different Earth Science disciplines. My research project is funded by the Spanish Ministry of Science. Over the next five months I will be working with Professor Andrew Roberts, with whom I worked as a post-doc at the National Oceanography Centre (UK) in 2000-2002, on the climatic implications of marine records of Saharan dust deposition. The main goal was to link variations in dust fluxes with landscape variability in the Sahara, which has not always been the hyper-arid desert that we know today. Past wetter periods turned the whole Sahara into a huge savannah that flourished with life and dampened dust production. By establishing the timing and duration of these so-called “green Sahara periods” as a baseline, we hope to better understand the effects of climate change on hominin population dynamics within tropical Africa. By better understanding the information provided by marine records of dust deposition in terms of landscape dynamics, we also hope to improve our knowledge of the long-term evolution of other desert-dominated regions, including Australia.

On the personal side, my wife Eva and two children, Íñaki (4) and María (1) are learning to adapt to life in Australia. The first shock when we arrived was that it rained for a week. This is not what we expected for the “driest inhabited continent on Earth”. Next came adapting to a different lifestyle: trying to understand Australian English, searching for schools for Íñaki, discovering several types of spiders at home and knowing which ones are the nasty ones, enjoying the last “barbies” of the summer, and – finally – encountering kangaroos, emus, platypuses and other iconic Aussie fauna (including a venomous snake) in the bush.

Oleg Koudashev

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ROCK STARS

Professor Gordon Lister
2012 Mawson Medal
Gordon’s work examines tectonic processes that lead to the building and destruction of mountain belts. He was one of the first scientists to demonstrate the importance of extensional tectonics in orogenic processes.

Dr Andrew Hogg
2012 Frederick White Prize
Andrew uses models of ocean circulation to understand the role of oceans in climate. He has discovered new ways in which the ocean can generate low frequency climate variability, and has applied this knowledge to the prediction of the ocean’s response to climate change.

Professor Patrick De Deckker AM
Fellow of the Australian Science Academy
Patrick has been be honoured as a new Fellow of the Australian Academy of Science for his internationally significant achievements in science, linking the patterns of environmental change on land and sea.

Hugh O’Neill FRS
Fellow of the Royal Society
This prestigious award recognises Hugh’s fundamental contributions to the study of mineral equilibria and their application to understanding planetary processes. Hugh joins a group of the world’s most distinguished scientists including Charles Darwin and Albert Einstein.

Coming up...

Jaeger-Hales lecture
Thursday, 26th July Professor Edouard Bard, Chair in Climate and Ocean Evolution at the Collège de France.

Alumni reunion
Tuesday, 7th August, 6.00-7.30 pm in Brisbane, International Geological Congress.

Conferences
The 22nd Goldschmidt Geochemistry Conference, 24-29 June, Montreal, Canada
Conference of the Australian Science Teachers Association, 8-11 July, Canberra, Australia
34th International Geological Congress, 5-10 August, Brisbane, Australia
Western Pacific Geophysics Meeting AOGS – AGU (WPGM), 13-17 August, Singapore

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