

The Geological Society
of Australia Inc

Newsletter Number 165
December 2012

tag



**Young Earth Scientists
see p25**



**Remains of RMS Titanic
see p29**

***International Earth Science
Olympiad success***

***Field trips in Australia and beyond
GSA recognises our members***

The Australian Geologist

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tag



Young Earth Scientist p25
Michelle Cooper



Feature p29
Nautilus Exploration Program
ROVs map seamounts and shipwrecks



Special Report p33
34th IGC
IGC wrap



FRONT COVER

High-resolution map of the M/S Dodekanisos, off the coast of Turkey, obtained during the Nautilus Exploration Program. Image courtesy Dwight Coleman.

- 2 From the President
- 3 Editor's Comment
- 4 Society Update
 - Governance Changes Update
 - Climate Change Policy
 - Business Report
 - Letters to the Editor
 - From the AJES Editor's Desk
 - Education & Outreach
 - Stratigraphic Column
 - Heritage Matters
- 17 News from the Divisions
- 20 News from the Specialist Groups
- 22 News
- 26 Recognition
- 44 Cam Bryan's Geojottings
- 45 Calendar
- 46 Book Review
- 47 Office Bearers
- 48 Publishing Details

From the President



out in the political arena. Please respond through the channels suggested in the article rather than bombarding the Executive Director, Sue Fletcher, with emails. All input will be addressed before the committee agrees to a final statement.

As well as the climate change statement, changes to the GSA

The International Geological Convention has now been and gone – and what a successful event it turned out to be. Congratulations to all of the organisers, particularly to Neil Williams as President and Ian Lambert as Secretary General, as well as the rest of the Organising Committee. All of the helpers and volunteers pulled together to deliver a world-class event. I was involved in a field trip to Mt Isa and was impressed by the organisation and support provided by the committee and trip organisers. An event of this magnitude can only be successful with a lot of hard work and organisation. Well done to all.

One of the issues that the Geological Society of Australia (GSA) has been grappling with over the last two years is a climate change position statement. An initial statement was released, but it proved to not be supported by many of our members. Following a members' vote, it was determined that the members wanted the GSA to have a position statement. However, the wide range of views of the members has made the wording of a statement difficult. Our Past President, Brad Pillans, has now produced a document that I believe encapsulates the feelings of the membership.

This document is included in this issue (*TAG* 165) for your perusal and comment. We are now getting to the stage where a finalised statement, which our members support, will be produced. While we are aware that many members have strong views on climate change and the possible causes, we have to produce a statement that encapsulates the inputs required for an informed debate and actions that we all agree can be made to benefit all of society. I think we can all agree that reduction of pollution of our planet is a worthwhile aim, while not getting bogged down in the blame game that is being fought

Governance Rules are also reaching finalisation. Our approach is to place the new Rules on the Society's website by mid-November and include them in this issue of *TAG*. We invite members to direct any comments and suggestions back to nominated members of their Division or Specialist Group for incorporation into their feedback before mid-December. Once again, we ask that responses are fed back to us through these channels rather than sent directly to the GSA office.

The timetable for implementation of the Governance Rules mean that the new Rules need to be finalised early next year so that they can be distributed to the members. For details on timing refer to the Governance update on pages 4–5. If the Rules are accepted by the membership, the new document will be ratified at the 2013 AGM, and the new procedures will be put in place to implement the new structure. Our intention is that any issues with the new Rules are dealt with before they are sent out to members. We hope that by this time any broad opposition to the new governance structure will be addressed and the vote will proceed without new issues being raised.

So, please respond to the document on governance changes through your Divisional committee or Specialist Group before mid-December so your voice is heard and your concerns can be addressed in the new Governance Rules.

Laurie Hutton

President



Editor's Comment

It would be surprising if any geoscientist had not heard by now of the astonishing outcome of the 'Italian earthquake trial'. As a postscript to the 2009 earthquake that killed over 300 people in the central Italian town of L'Aquila, six geoscientists and a government official have been sentenced to jail for six years for manslaughter, based on their providing "... ineffective, incomplete, imprecise information" about the risks. That their original advice may have been mis-stated by a government official doesn't alter the fact that, as we all know, the term 'earthquake prediction' has something of an oxymoronic character, despite considerable attempts to improve it by various methods.

Consider the likely repercussions of this outcome: no scientist in Italy will be willing to offer any advice to government that involves predicting uncertain events. For example, what must the vulcanologists at the observatory stationed on Mt Vesuvius, perhaps the most dangerous volcano in the world, be thinking? Of course, it's most unlikely this outcome will have international repercussions, and may even be overturned on appeal given the strong international protests. But it does raise an interesting discussion point. In this case, we have the scientific community strongly protesting a judgement that punishes qualified scientists who, on the basis of available evidence, made a prediction that a catastrophic event would not occur. What then should be our response if a panel of international scientists made predictions, again based on all available evidence, that a catastrophic outcome is highly likely to occur unless we make some fundamental changes? You'd hope the answer is obvious!

Generally, keeping an eye on the technical content of *TAG* is plain-sailing, as most contributions require little more than a grammatical 'tweak' here and there. Occasionally, however, a



more 'challenging' scenario arises, which tends to sharpen the wits. In the last few months we received two potential contributions, both submitted in time for this issue. One was on a topic that was 'iconoclastic' in approach and amounted to something of a personal crusade. The other was more evidence-based with extensive references on the global warming/climate change issue. When the former contributor was informed of my decision, made after consultation, not to publish in *TAG* and advised to submit to *AJES*, the immediate response I received was aggressive and unpleasant, with accusations of censorship. When the second author was advised of my decision not to publish, the response I received was courteous and understanding. I couldn't help but think that these completely contrasting responses represented two extremes in which debate is currently conducted on a number of scientific issues. Perhaps it's too big a leap to make that connection, but that impression has stuck with me.

BILL BIRCH

GSA and facebook

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Society Update

Governance Changes Update

Late October 2012, the GSA Governance Committee sent a memorandum to the Division, Specialist Group and Branch Committees, accompanied by an advanced version of the Revised Rules. That memo outlined the background, progress, and time lines for the proposed changes to the Society's governance and, most importantly, a final opportunity for feedback on the Revised Rules by 21 December 2012.

On 14 November 2012 individual GSA Members were advised by email that the Revised Rules had been loaded on to the Society's website and their feedback was also requested, via an affiliated Divisions, Branch or Specialist Group. To be effective, this individual Member feedback will need to be with one of those affiliated groups by 14 December, to allow time for collation ahead of the deadline.

Background

As you are aware, the National Executive Committee, through the agency of its Governance Committee, has been working to modernise the governance of the Society as directed by Council in 2010. The progress report in the June 2012 edition of *TAG* outlined the Executive's plans for implementing the changes required to ensure that the Society will be fully compliant with the legal Act that enables its all-important not-for-profit status. This report followed earlier consultation with Divisions, Branches and Specialist Groups and subsequent adjustments to the Rules, following their generally positive feedback.

A second progress report in the September 2012 edition of *TAG* advised that the Revised Rules were endorsed at the Council meeting on 5 August and at the Annual General Meeting (AGM) on 6 August, subject to relatively minor amendments. Following these amendments, and further consideration by the Executive, they were submitted to Divisions, Branches and Specialist Groups for final consultation and feedback in late October and to individual Members in mid-November.

The key objective of the changes is to provide for an elected National Governing Council to replace the current National Executive Committee appointment system. This Governing Council is proposed to be the peak decision-making authority of the Society. In recognition of the value of the broad discussion that involves all Divisions, Branches and Specialist

Groups directly, the current biennial Council meeting would be replaced by a forum at the biennial Convention, attended by representatives of Divisions, Branches and Specialist Groups, and members of the Governing Council.

Remaining work in 2012

Our timetable is aimed towards achieving a ballot of Members on the Revised Rules by the next AGM in May 2013. If this ballot results in the approval of 75% of voting Members, the Executive would then complete the remaining steps required for the Governing Council to operate immediately following the AGM in 2014. To achieve this we emailed the membership to seek feedback from Members through their Divisions, Branches or Specialist Groups by 14 December 2012. For us to properly consider and accommodate your feedback and also to ensure that we provide individual Members with adequate access to the final version of the Revised Rules well in advance of the 2013 ballot, we must be firm about the 21 December deadline.

To succeed, the vote will require 75% approval of those Members that vote in 2013 and therefore the completeness of the consolidated responses we receive from the Divisions, Specialist Groups and Branches will guide the completeness of the final amendments to the Revised Rules. In other words, we urge that your first reading of the Revised Rules is in 2012, rather than 2013.

While we recognise that the proposed changes will not please all Members, we have experienced widespread support for the concept of modernising the Society and increasing its effectiveness and value to Members, irrespective of the changes required under the Act. There has also been a strong commitment to change within the Executive over the last 3–4 years, motivated by the best long-term interests of the Society.

Timetable for 2013–2014

The new Rules must be accompanied by a revised set of Procedures that will guide some of the detailed operational processes for a Governing Council and its associated Executive. These are now being prepared and will be made available for review in early 2013. The Procedures do not require formal approval by Members; however there will be adequate opportunity for Divisions, Branches, Specialist Groups and individual Members to comment before being finalised prior to the AGM in 2013.

Actions scheduled for 2013 include:

- January/February: incorporate feedback 2012 and finalise Rules.
- March–April: final Rules and ballot papers forwarded to all members.
- External provider to manage the ballot.
- All postal ballots counted before Annual General Meeting.
- Late May: Annual General Meeting.
- The outcome of the postal vote will be announced at the AGM.
- Members notified of outcome.

If the Revised Rules are approved, the Executive will then initiate arrangements to enable a call for nominations for election to the Governing Council in 2014, and to undertake the associated election process. It will also initiate discussions with the first four Divisions to be represented on Council to ensure that these appointments are known prior to the ballot for the first five General Councillors. The timetable for representation will be finalised in the coming months.

Election of the General Councillors and appointment of the Divisional Councillors will be completed in time for ratification at the 2014 AGM and for the Governing Council to commence operation immediately following the AGM.

Thanks and regards

Jim Ross on behalf of the Governance Committee—Ian Graham, Laurie Hutton, Jim Ross, Chris Yeats and Sue Fletcher

The Draft Rules are accessible from the GSA website at <http://gsa.org.au/management/rules.html>, or by contacting your Division, Specialist Group or Branch Committee.

Member feedback should be sent to the contact for your Division, Branch or Specialist Group, as listed on the website. Sending your feedback to them provides them with an opportunity to hear your opinions; they can then send your comments to the GSA Executive Committee as consolidated feedback representative of their Division, Branch or Specialist Group.



TAG The Australian Geologist

GOT SOMETHING TO SAY?

Send your contribution to the TAG column 'Forum', where GSA members can voice their opinions, advice, criticism and recommendations.

CONTACT US: tag@gsa.org.au

Society Update

Climate Change Statement

The Executive Committee of the GSA has produced the following draft Climate Change Statement after a prolonged period of consultation with GSA members. In line with feedback from members, the statement emphasises the geological record as an archive of past climate change and how it can contribute to our understanding of future climate change.

The Executive Committee recommends that the statement be adopted by the Society, but welcomes further member feedback no later than 31 January 2013. This will be followed by consultation with Divisional and Branch committees during February 2013, after which a final statement will be endorsed by the GSA Executive and placed on the GSA website. All comments should be emailed to climatechange@gsa.org.au.

Draft GSA Climate Change Statement

The Geological Society of Australia (GSA) has developed this document as a science-based statement regarding climate change,¹ emphasising the contributions that Earth Science can make to the public discussion. This Statement provides the views of a learned Society dedicated to investigation in Earth Sciences and is made by the Executive Committee of the GSA, after wide consultation with Society Members who are qualified Earth Scientists largely working in or retired from academic, industry, government and public sector organisations.

The nature of the geological record

Instrumental records of global climate are short when it comes to estimating future climate changes because many of the processes that control global climate operate on very long time scales by human standards. Current debate about the causes and consequences of global climate change can be informed by studying the geological record of past climate changes on time scales from decades to billions of years.

The geological record provides the key source of information regarding Earth's past climates, including periods when global climate was both significantly warmer and colder than the present. Important climatic archives include sediment cores from the oceans (up to tens of millions of years old), ice cores from Greenland and Antarctica (up to 800 000 years old), as well as marine and continental sedimentary rocks that may be hundreds of millions of years old. Evidence may include the distribution of fossil plants and animals, the past distribution of ice on the Earth's surface, and estimates of temperature and atmospheric composition based on geochemical measurements, to name just a few examples. In some cases, the

geological record may be very detailed and young enough to overlap with instrumental records of climate (eg, annual growth layers in corals).

Variability of past climates

Geological evidence clearly demonstrates that Earth's climate system is inherently and naturally variable over time scales from decades to millions of years.²

Some 50 million years ago, mean global temperature was about 6°C warmer than today. Since then, Earth's climate has fluctuated but has been generally cooling as large ice sheets formed, first in Antarctica and then in the Northern Hemisphere. Over much of the last 2–3 million years the climate has typically been colder than today, often much colder, when the growth of ice sheets during 'glacial periods' caused sea levels to be more than 120 m lower during the largest glacial advances. These glacial periods have been interspersed with intervals of warmer climate, referred to as interglacial periods. The Earth is currently in an interglacial period, called the Holocene Epoch. There have been some 50 glacial/interglacial cycles during the last 2.6 million years. The present glacial/interglacial cycle began some 115 000 years ago with a major global cooling event and growth of ice sheets progressively extending from the polar ice-caps to lower altitudes/latitudes. This glacial period peaked about 20 000 years ago, when global temperature was some 5°C colder than today, and was then followed by progressive warming, ice melting and sea-level rise that led to the present interglacial. We know also that during the last 15 000 years interruptions to the gradual warming occurred, with both rapid cooling and warming episodes sometimes occurring over time periods as short as a few decades.

Causes of past climate changes

Earth's climate is sensitive to a variety of factors including:

1. Planetary-scale controls such as solar and orbital variability and large impact events.
2. Tectonics and plate movements, including large volcanic eruptions, which have major long-term influences on weathering, erosion, surface temperatures and ocean/atmosphere circulation.
3. Earth-specific factors such as biological feedbacks, surface albedo and atmospheric composition, including dust and other particulates. Human activities may impact on these Earth-specific factors to cause anthropogenic climate changes, both locally and globally.

Climate sensitivity

A detailed, scientific understanding of the climate history of the Earth, based on the geological record, is essential to appreciate and quantitatively unravel the various sensitivities contributing to climate variations both short-term and long-term. The term 'climate sensitivity' is used to describe the change in globally averaged temperature that is caused by a given amount of climate forcing. For example, the sensitivity of global climate to variations in Earth's orbital parameters (axial tilt, orbital eccentricity and precession) is known to be around 5 to 6°C during glacial/interglacial cycles of the past 2–3 million years. However, orbital forcing alone cannot account for this magnitude of sensitivity – there are complex feedback mechanisms that amplify the orbital forcing, some of which are reasonably well understood and some of which require further research and testing to be well understood.

Future climate

The geological record clearly shows that the Earth's climate will change from what it is today. The critical question, however, is the direction, rate and scale of change and consequent environmental effects on essential human activities such as agriculture and settlement patterns. Geological archives of past climate changes merit careful study to better understand Earth's complex climate system, including the primary controls and feedback mechanisms that cause these changes.

Regardless of whether climate change is from natural or anthropogenic causes, or a combination of both, human societies would benefit from knowing what to expect in the future and to plan how best to respond. Just as we now attempt to prepare for intense, but short-lived disasters

such as earthquakes, tsunamis, landslides and volcanic eruptions, so preparations should be made for other variables such as climate change that may have more widespread and longer term effects. The GSA makes no predictions or public policy recommendations for action on climate beyond the generally agreed need for prudent preparations in response to potential hazards, including climate change.

Scientific approach

Science seeks to explain natural phenomena using natural laws, verifiable and reproducible observations and logical analysis; it reaches explanations that are always subject to amendment with new evidence. Our understanding of the geological record of past climate change should be based on the best available peer-reviewed science. The GSA encourages those interested in following the debate on climate science to attach greatest credence to the communications of those scientists commenting within their fields of expertise, as defined by their peer-reviewed publication record.

BRAD PILLANS

Past President, GSA
26 October 2012

FOOTNOTES

¹The term 'climate change' is used throughout this document to refer to all climate changes, whether natural or anthropogenic, regardless of cause.

²An excellent review paper is Zachos *et al* 2001. Trends, rhythms, and aberrations in global climate 65 Ma to present. *Science* 292: 686–693.



Scan for the latest GSA news.

Society Update

Business Report

As the year draws to a close you should have received your 2013 membership renewal, which included a Member Update, news about the National Rock Garden and the end-of-year book sale. If you haven't received yours or it has been misplaced, please contact the office. The book sale is one you do not want to miss, especially as it includes a bumper sale of 50% off the Association of Australasian Palaeontologists *AAP Memoirs* 1–34. With those discounts, they are sure to be a welcome addition to most 'Santa sacks'.

This issue, we include a wrap-up of the 34th International Geological Congress and reports from GSA Division and Specialist Group sponsored students – see pages 33–43. We also include a feature on research from the E/V *Nautilus* Exploration Program from Dwight Coleman. The inside and front covers include some interesting images related to this feature. We also have news from our regular columnists and updates on Divisional activities.

Also in the issue, I wish to draw your attention to the next update on the GSA Rules and Governance changes on pages 4–5 and on the revised Climate Change Statement on pages 6–7. In this issue we recognise a number of members for their achievements, including Young Earth Scientists and GSA Fellows.



Yet again, I wish to congratulate the many GSA members who volunteered their time organising talks, field trips, symposia and conferences, as well as writing field guides, preparing Abstract volumes and publications, and serving on committees. Contributions from volunteers are essential to the health and well-being of many associations. Volunteering also enhances careers, as volunteers develop new skills, receive mentoring and build working relationships that stand the test of time. So thank you to the members who have volunteered their time and expertise. Thanks to the regular contributors to *TAG*, and to the organisers of local meetings and talks – your efforts make a huge difference to the Earth Sciences.

Enclosed in this issue of *TAG* is an order form for Geoscience Australia's landmark publication *Shaping a Nation: a geology of Australia*. This is a substantial publication that you will enjoy for many years and it's just perfect for a summer read.

Enjoy your end-of-year break. Maybe read one of the books listed at the end of this issue and write a review, or think about writing a news article about your local area or favourite geological haunt. And remember to renew your membership so you can stay connected and be sure not to miss out on *AJES* Volume 60, issue 1, published early in 2013.

SUE FLETCHER
Executive Director

TAG The Australian Geologist

SCHEDULE & DEADLINES

ISSUE	COPY	FINISHED ART	INSERTS
MARCH 2013	28 Jan	1 Feb	1 Mar
JUNE 2013	29 Apr	3 May	28 May
SEPTEMBER 2013	29 Jul	9 Aug	23 Aug
DECEMBER 2013	25 Oct	1 Nov	8 Nov

CONTACT US: tag@gsa.org.au

Congratulations Ian!

Dr Ian Lambert, Secretary General of the 34th International Geological Congress and long-term GSA member, was appointed Secretary General of the International Union of Geological Sciences.

Ian will work hard to ensure Australia's reputation in the international geoscience community continues to grow.

New members

The GSA welcomes the following new members to the Society. May you all have a long and beneficial association with the GSA.

ACT

STUDENT
Andrew Clark

NSW

STUDENT
Hugh Bannister
David Flannery
Nicholas Latham
Gavin Smith
Thomas Walters
Ian Wilson

SUBSCRIBER
David Le Bas

MEMBER
Catherine Chague-Goff
Dean Collett
Lize Stander

Mark Stander
James Goff

QLD

STUDENT
Emily Anderson
Emma Beattie
Kallan Carthew
Patrick Coolet
Tracey Crossingham
Peter Pasini
Joel Vos
Xin Ning Yong

GRADUATE
Kieran O'Loughlin

MEMBER
Eryn Bergin
Glenn Simpson

SA

GRADUATE
Philip Luu

STUDENT
Josephine Goonan
Nick Lyons
Kieran Meaney

MEMBER
Millicent Crowe
Ian Lewis

TAS

MEMBER
Gail Gnoinski
Taryn Noble
Benjamin Waining

VIC

AFFILIATE
Geoff Lacey

STUDENT
Farah Ali
Sanjeeva Manamperi
Scott Ooi
Tyler Stewart

WA

MEMBER
Milo Barham
Robert Hough
Tim O'Callaghan

Lost members

Mail from the following members has been returned to the GSA, as all their contact details are out of date. If you know these members and have their contact details, please email info@gsa.org.au or call 02 9290 2194. Thanks in advance for your assistance.

Jorham Contreras

Stuart Ellar

Matthew Jones

Chris Kojan

Helen Tribick



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Archean Evolution - Yilgarn Craton

as a thematic issue in the *Australian Journal of Earth Sciences* (2012, volume 59, issue 5)

&

Early Earth

a special issue of *Precambrian Research* (in press, articles online at www.journals.elsevier.com/precambrian-research/)

For information about Geoconferences go to: www.geoconferences.org

GSA and climate change

To the Editor,

Ex-president Peter Legge (*TAG* 163, June 2012) and most members of GSA have indicated they wish the GSA to state its position on man-made climate change. May I disagree with people I respect.

Peter's considered comments show that while our society is split down the middle, the only agreed statement must be minimalist: "Things are complex and change." That will not be useful, and GSA should be leading the science. Nor is consensus valuable in science, only evidence and logic.

People accept that natural causes affect climate. My barber-shop told me so. Yet many are convinced that the current rise in CO₂ is causing the current rise in temperature. Rather than generalisations, let us rigorously assess the records. How many of our members, all busy, are on top of the literature of *both sides* and have fully informed views? Not me, and I cannot access nor assess all of the literature.

GSA should do the scientifically educational thing. Have the proponents of the pro and con positions spell out their cases clearly and systematically, together, enabling us to compare and contrast. It will be a gift to all non-experts, and to some 'experts'.

Two stages are required:

Both sides select and assemble the key data and analysis for their case. Maximum 20–30 pages each. Let the papers fill an entire *TAG* or go into [*AJES*]; this is the subject of a generation. Have the major tables and graphs of each case, and assess the quality of evidence. Each side is to state the problems and weaknesses of its own case, the gaps in the data. No modelling, just the geological/meteorological data and analysis, emphasising geological. The Earth is *the* laboratory that should tell us what factors and constants to put in models. We should also discuss the health of sea life and reefs in high T/CO₂ regimes for eons. *Zero ad hominem* comment. The large bibliographies should be only on the website.

After the cases are published, give both sides four months to comment in five pages each on the two cases. Criticise, retract, clarify. That is science. *Zero ad hominem* comment. That would be as valuable as stage 1.

Thereafter, we revert to individual papers for some years, before the next overview.

The GSA would present world-class rigorous scientific benchmarks.

Peter is right that the exercise should stick to science, and not tout for funding.

If the GSA rejects this approach, make sure it does something scientifically better.

ROSS FARDON

Reply to letter by Phil Brown in *TAG* 164, September 2012 p7

Dear Editor,

In his letter (*TAG* September 2012, p.7) Phil Brown asks or states, amongst others:

1. "How do you know that increasing CO₂ levels actually cause global warming?"
2. "At least some ice ages have occurred irrespective of elevated levels of CO₂."
3. Cites a severe winter in Europe as a reason for questioning global warming.
4. Suggests "the more CO₂ in the atmosphere, the more plants and trees grow".
5. Enquires regarding my view on the Coalition's biochar policy.

I respond in the same sequence.

1. The resonance effect of internally vibrating molecules allowing the infrared absorption–emission effect of gases (H₂O, CO₂, CH₄, O₃, N₂O), consistent with black body radiation laws (Planck, Stefan–Boltzmann and Kirchhoff laws),¹ has been demonstrated experimentally since Svante Arrhenius [in] 1896.² Empirical evidence from proxy-based paleo-climate research, which uses oxygen and carbon isotopes, trace elements and fossil plants,³ has followed, establishing the relation between greenhouse gas and temperatures. During glacial terminations, warming of the oceans triggered by orbital forcing decreased the solubility of CO₂, releasing the gas to the atmosphere, which in turn

led to further warming of the surface.⁴ Since 1750, anthropogenic release of more than 560 billion ton of carbon (GtC) (close to the original atmospheric level of 590 GtC) from burning of fossil fuels and land clearing, has pushed atmospheric CO₂ from ~280 ppm to ~400 ppm – the highest level since the late Pliocene (2.6 Ma).

2. As shown by paleoclimate studies,^{3,5} glacial and cold periods (Carboniferous–Permian, parts of the Jurassic and upper Cretaceous) were marked by low CO₂ levels. An exception is the end-Ordovician, a period of low solar luminosity which balanced high CO₂ levels. According to Young *et al* (2009)⁶ high weathering rates in the mid-Ordovician led to lowering of CO₂ levels below 3000 parts per million which, in view of low solar luminosity, resulted in glaciation.

3. Increased energy levels related to global warming result in increase in climate variability and in extreme weather events, including heat waves, cold fronts, an intensified hydrological cycle leading to floods and intense hurricanes.⁷ The progressive decrease in summer and autumn Arctic sea ice results in increased evaporation from ice-free open water surfaces, migration of cold vapour-laden fronts into the North Atlantic and ensuing snow storms in west Europe and North America, as in 2010–2011, as stated by Liu *et al* 2012:⁸ "*Moreover, the increase in atmospheric water vapor content in the Arctic region during late autumn and winter driven locally by the reduction of sea ice provides enhanced moisture sources, supporting increased heavy snowfall in Europe during early winter and the north-eastern and midwestern United States during winter. We conclude that the recent decline of Arctic sea ice has played a critical role in recent cold and snowy winters.*"

4. CO₂ may enhance growth where water is available, for example in irrigated greenhouse glass enclosures. However, in the case of greenhouse-gas-generated global warming, the ensuing droughts, floods and extreme weather events damage plants and agriculture. Further, while CO₂ enhances the growth of some plants, it may be toxic for other plants.⁹

5. Whereas application of biochar on a small scale is feasible in principle, its application on a large scale for the purpose of draw-down of atmospheric CO₂ remains to be tested.

ANDREW GLIKSON

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DISCLAIMER:
The Geological Society of Australia encourages letters from members.

The letters do not necessarily represent the opinion of the Society.

Response to letter on the Dorothy Hill Library collection in TAG 164, September 2012 p7–8

Dear Editor and Readership of TAG,

As the newly established Dorothy Hill Professor of Palaeontology and Stratigraphy at the University of Queensland it is with heavy heart that I acknowledge Tim Munson's recent letter to TAG [TAG 164, September 2012] where he noted the loss of significant research and teaching collections from the Dorothy Hill Engineering and Sciences Library. As Tim stated, a large segment of the palaeontological and stratigraphic literature painstakingly acquired by Professor Dorothy Hill and colleagues over almost a century was discarded by the library through a veritable comedy of errors in late 2010 and early 2011.

To add to the irony mentioned in Tim's letter, this resource was discarded at about the same time that I was moving to the University of Queensland as part of a major new investment in palaeontological and stratigraphic research in the School of Earth Sciences. That investment was meant to enhance an already substantial critical mass in paleobiology at the University where 14 academic paleobiologists teach and/or carry out research in five separate schools spread between two faculties. Few universities have a greater investment in paleobiology than the University of Queensland.

Although it is challenging not to be 'backward looking' in regards to the incident, especially for one trained to study Earth history, I can report the very positive stance taken by University Senior Management to remediate the library losses. Extensive resources have been made available from central funding and the Faculty of Science to rebuild and reinvigorate the collection so as to again serve the needs of researchers and students at the University and in the broader community. Importantly, the University has retained the services of Dr Peter Jell, a well-known Australian paleontologist, to help assess needs, reacquire materials and rebuild the collection. Peter Jell has extensive knowledge of the broader palaeontological and stratigraphic literature and is a previous editor of the Memoir series of the Association of Australasian

Palaeontologists. He also has personal knowledge of the University of Queensland library collection as well as all the other major geological research libraries in Queensland through his previous involvement as Head of Geosciences at the Queensland Museum and most recently at the Geological Survey of Queensland where he has just edited the new comprehensive volume on the Geology of Queensland. Appointment of such a qualified individual to lead the recovery of the collection indicates the University's intention to support teaching and research in paleontology and the broader Earth Sciences well into the future.

So, while acknowledging the loss of this unique collection, the way forward is to rebuild, and in that regard, we are grateful for any help that you can give. It is the firm intention of the University to restore the collection as best possible to its former glory and we are actively seeking replacements for the material that can be replaced. If you have, or know of, rare palaeontological/stratigraphic literature that is seeking a good home, please contact Dr Peter Jell at p.jell@uq.edu.au

Finally, I hope that this incident may serve as a warning to the broader geological community. If such a significant collection could be accidentally discarded from the Dorothy Hill Library without the knowledge or consent of the relevant academic staff, it could happen elsewhere. The modern obsession with digital formats and online journals, and the assumption that all knowledge is available somewhere online, renders many of our rarest resources increasingly vulnerable.

Without a vocal scientific community to identify and champion our hard-won, long-term resources and datasets, they may all be vulnerable. Sadly, the same is likely true for physical collections of rocks, fossils and geochemical samples held in financially stressed public institutions. I hope that the events of late 2010 and early 2011 in the Dorothy Hill Library will help unite Earth Scientists, and perhaps academics in general, and inspire them to take more active roles in securing the future of the resources on which we all depend.

GREGORY E WEBB
Brisbane

From the *AJES* Hon Editor's desk

AJES Impact

Open Access

The movement towards open access (OA) began in the 1990s and has grown with the development of the internet. The OA movement is commonly articulated in terms of transparency and public access to publicly funded research. Many funding bodies, particularly in Europe and North America, require and fund publication in OA journals. Every major traditional academic publisher offers authors access to OA publication that includes offering hybrid OA at article level as well as pure OA journals. *AJES*, through our publisher Taylor & Francis, now offers hybrid OA to authors.

There are many types of OA. For example, science articles are available immediately OA on payment of a fee (gold OA) or after an embargo period in an Institutional Repository or Subject Repository at no cost (green OA). For a more detailed explanation of the types of OA available and the issues involved look at Peter Suber's site at <http://www.earlham.edu/~peters/fos/overview.htm> for an informative overview. Wikipedia also provides a simple explanation.

After acceptance, authors of *AJES* papers will be given the option to sponsor access for non-subscribers. If authors take this option, and pay a fee, these articles become OA. As with OA journals, the article processing fee (currently US\$2950) covers the costs associated with publishing, including managing the peer review process, supporting our publishing and hosting platforms, typesetting, marketing and other publishing costs. The process for authors who choose not to take the option for OA will remain unchanged. For more information on Taylor & Francis's Open Access program, see the Author Services site at <http://journalauthors.tandf.co.uk/preparation/OpenAccess.asp>.

Strategic planning for *AJES*

In March, the Editorial Board (EB) was asked to identify the good and the bad of the journal and current publication contract. These were discussed with Taylor & Francis at a meeting held in Canberra that was attended by several members of the EB and Sue Fletcher. With an overall positive view of the journal and its content, several areas of improvement were identified, as well as issues that were poorly understood. Some of the issues raised are summarised below.

Copyright

GSA is the copyright owner for most published papers. Some organisations retain copyright and give GSA a licence to publish. The ownership of the copyright is identified on the first page of each paper. Publishers such as Taylor & Francis do not own the copyright and if a new publisher is contracted the digital files are transferred to the new publisher.



Journal content

The *AJES* content is highly regarded by members of the EB. This is consistent with our impact factor and ranking of the journal. Thematic issues and review papers are of particular interest to readers. If you have proposals or suggestions for thematic issues or review papers please contact me.

Pre-publication of papers has reduced the time for publication, particularly for thematic issues where delays can be significant. Each paper submitted is processed individually and as soon as the proofs have been corrected and approved, papers are published online (see Forthcoming Papers on the *AJES* website). The publication date for a paper is the date it is published online and not the print date.

The alert system on the website can be set up so you receive an email when new papers are uploaded. These emails include the authors and title of the new paper plus a hotlink to the paper.

Printing

AJES is currently printed in Australia using offset printing, which results in high-quality images and text. The decision to print in Australia has been the GSA's. In the past this has added to the costs and meant charges for colour in print. All the issues relating to printing will be re-evaluated as part of the tender process but at least for the next contract period we are planning to retain the option for printed copies from members.

Colour images

Colour is free for online publication. There is currently a charge for colour in print and occasionally we publish a full-colour issue where we obtain external funding. As part of our current contract with Taylor & Francis there are five free colour pages per issue, which I allocate among authors.

Cost of downloads

The cost of downloads of papers from the *AJES* website for non-members has been questioned. Download charges are paid by non-members who do not have access to libraries with *AJES* subscriptions. This issue is a difficult one. Currently GSA and Taylor & Francis have a profit-sharing arrangement for the sale of subscriptions and individual downloads. These funds are important to GSA and without them members' costs would need to increase.

Upcoming in AJES

Research papers

JH Cann & CV Murray-Wallace: Interstadial age (MIS5c) beach-dune barrier deposits in the Coorong Lagoon, South Australia.

RA Glen: Refining accretionary orogen models for the Tasmanides of Eastern Australia.

M Honda, D Phillips, MA Kendrick, MK Gagan & WR Taylor: Noble gas and carbon isotope ratios in Argyle diamonds, Western Australia: evidence for a deeply-subducted volatile component.

BLN Kennett & M Salmon: AuSREM: Australian Seismological Reference Model.

DF Lascelles: Banded iron formation to high-grade iron ore: a critical review of supergene enrichment models.

AJES Vol 60/1 CO₂ sequestration

Alex Golab and Sue Golding (Eds)

P Cook: Introduction for thematic issue on CO₂ sequestration.

*M Bunch: Gauging geological characterisation for CO₂ storage.

*A Golab: 3D characterisation of potential CO₂ reservoir and seal rocks.

L Stalker, S Varma, D Van Gent, J Haworth & S Sharma: South West Hub – a carbon capture and storage project.

*J Hodgkinson & M Grigorescu: Background research for selection of potential geostorage targets – case studies from the Surat Basin, Queensland.

S Farquhar, G Dawson, J Esterle & S Golding: Mineralogical characterisations of CO₂ sequestration in the Surat Basin.

S Golding, T Uysal, R Bolhar, C Boreham, G Dawson, K Baublys & J Esterle: Carbon dioxide-rich coals of the Oaky Creek areas, central Bowen Basin: a natural analogue for carbon sequestration in coal systems.

K Pinetown: Assessing the CO₂ sequestration potential of coal seams in the Hunter Coalfield, Sydney Basin based on a natural analogue study.

L Divko Goldie, G O'Brien, P Tingate, J Miranda, M Campi & K Liu: Basin-scale fluid flow in the Gippsland Basin: implications for geological carbon storage.

*S Varma, J Unterschultz, S Giger, B Field, L Roncaglia, J Hodgkinson & D Hilditch: CO₂ geosequestration potential in the Northern Perth Basin, Western Australia.

*published online.

Australian Journal of Earth Sciences

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GSA member William Clarke

GSA member William Clarke passed away on 20 January 2012.

William had a full collection of AJES dating back to 1953.

William's wife, Lyn, would like to donate this collection to either a GSA member or a library.

If you would like William's collection, please contact Lyn at L_clarke@exemail.com.au

Education&Outreach

The 34th International Geological Congress (IGC) is long over and Earth Science Week has come and gone. Geoscience oriented documentaries have had their run on television and we are not far off winding up business for the Christmas holidays. Does that mean outreach activities are done and dusted for the year? I guess for many of us it is a resounding "yes" but as I said in my last column we ignore the 24/7 world of social media at our peril.

Perhaps it is just a sign of the times. No sooner had the ink dried on the last issue of *TAG* than the power of social media was writ large in the conventional media as it documented the influence social media can have on the future of controversial radio personalities, high-profile politicians and sporting heroes. Now, as I write this column, we see six Italian scientists found guilty of manslaughter – further highlighting the power of words and the perils of the public communication of science.

We know public support for science is crucial but a public poorly educated in the ways of science, the language of science and the limitations of science is in danger of elevating the statements made by scientists to heights they are not worthy of. On the other hand, some scientists use words and phrases in the public domain that are ill-considered or are easily misinterpreted or misunderstood. Irrespective of the reasons for the Italian court's decision it highlights a dilemma for those of us engaged in the public communication of science, whether in mainstream media or social media. No doubt some will be scared off ever talking to the media again. The reality is, though, that many scientists and the media teams that support them need media of all kinds to tell the public about their research and to rally that vital public support.



Is there a way forward? The simple answer is yes, although with a back-to-the-future caveat. With the rise of the desktop computer, dubious spell-checking software, ever-shorter deadlines and the 'do-more-with-less' funding imperatives from governments, business and other agencies has come a concomitant decline in the external review process and editing of documents destined for public consumption. Social media, with its ability to reach millions the moment a comment is 'published' just makes this situation worse. However, the way forward is easy to see: simply don't publish anything without an internal or external review and always make sure the penultimate product is competently edited. This all means the final publication is as good as it can possibly be, as accurate as it can possibly be and as beyond misunderstanding as it can possibly be.

This does not mean we have to sanitise all comments to the point of being meaningless. It just means we need to adjust our work program, our business model and our expectations to allow everyone in the public communications chain enough time to digest what is being said – and reflect on whether it is appropriate and if it can be said any better. A picture may be worth a thousand words but time to reflect, review and edit can take that thousand words and shape them into a 500-word masterpiece.

GREG McNAMARA

Geoscience Education and Outreach Services
Send all comments to Greg McNamara at outreach@gsa.org.au



The Australian Stratigraphic Lexicon — what you can and can't find online

Many young scientists seem to assume that everything they need to know is available online or in digital format. While all of us might like that to be true, most of this column's readers probably know better. Nevertheless, I thought it would be useful to give an overview of the digital and non-digital resources of the Australian Stratigraphic Lexicon.

The development of the Australian Stratigraphic Lexicon went hand-in-hand with the development of codes and guidelines for naming and describing Australian stratigraphic units. Although it has had various names over the years, the Central Register of Stratigraphic Names (or Stratigraphic Index) was started in 1949 and has continued ever since in various formats. The register initially assisted with the publication of the Australian volumes of the International Stratigraphic Lexicon, containing the names, definitions and key references to the existing Australian geological units at the time. These volumes were compiled and published between 1951 and 1966 through cooperation between the State Surveys, universities and the Bureau of Mineral Resources (BMR). An index volume was published in 1975 and an international Antarctic volume was finally published in 1983. These volumes are still useful for research on long-established names and should still be held in most State Survey and university libraries.

Over the years, the Lexicon has used the technology of the day, starting life as a card file (which is still held in Geoscience Australia), with regular reporting of updates to State Surveys and universities through 'Variations Lists'. As early as 1974 the possibility of computerisation of the Lexicon was discussed and in 1979 input to the Geological Index Database (GEODX) commenced. Hardware and software have changed over the years, and in July 1995 the database was the first in the Australian Geological Survey Organisation (now Geoscience Australia) to become searchable from their website.

GEODX is now known as the Australian Stratigraphic Units Database (ASUD). It aims to provide up-to-date information from over 15 000 indexed publications that discuss Australian stratigraphy. It includes information on over 16 000 current units and 33 000 superseded, obsolete or mis-spelt units and is used to underpin Australia's national geological datasets. There were around 11 000 updates made to unit information in the last year. So, the online database is pretty good at providing information on units established since 1979. Regrettably, it does not contain all the historical data. So, for units established earlier, the 'first reference' information given in the ASUD web search may be misleading because it only refers to the first reference in the digital part of the Stratigraphic Lexicon.

While the main focus for ASUD staff is to capture new references and data, legacy 'card file' data have been entered into the database back to the early 1960s for most units. All the old Definition Cards are digitised, making it easier to review and supply these data to clients. Various small projects have been undertaken to add some unit definitions found in the old BMR Technical Files and various State Survey Records. All the card file data for a few of the very long-standing units have also been added to the digital database in response to client enquiries. However, for some units there is still useful information on descriptive references that is only held in the old card files.

So, if you don't find all the information you need in the online ASUD database, ask if there is any more in the card files!

CATHY BROWN

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Other Stratigraphy Commission contacts are available at:
http://www.gsa.org.au/management/standing_committee.html
or through
<http://www.ga.gov.au/products-services/data-applications/reference-databases/stratigraphic-units.html>
or <http://tinyurl.com/8wfvjqzv>

Congratulations Kurt!

Kurt Lambeck, Australian National University, is the recipient of the 2012 Balzan Prize for Solid Earth Sciences.

Enric Banda, Research Professor of Geophysics at the Institute of Earth Sciences in Barcelona and President of Euroscience, Strasbourg, read the citation for the prize, with emphasis on interdisciplinary research, to Kurt Lambeck:

"For his exceptional contribution to the understanding of the relationship between post-glacial rebound and sea-level changes. His findings have radically modified climate science."

Heritage Matters

On 8 August, during the IGC week at the Queensland University of Technology (QUT), the GSA facilitated an international information session entitled *State of the Art in the Discipline of Geoheritage*. It attracted 22 geoscientists from around the world who practice in the arena of geoheritage. Countries represented at the session included Australia, New Zealand, the UK, the USA, Hong Kong, China, Iran, Portugal, South Africa, Uganda and Romania, with apologies from Professor Shrikant Limaye from India. The event was sponsored by the GSA, the GSA (Qld Division) and QUT. A very brief summary of this historic event follows.

Dr Laurie Hutton, at that time the incoming GSA President, gave the opening welcome. Then followed presentations by Dr Lars Erikstad (Executive Secretary, ProGEO, Natural History Museum, Oslo, Norway and Institute of Nature Research, Norway), Associate Professor José Brilha (University of Minho, Portugal) and Dr Kevin Page (University of Plymouth, UK).

Lars Erikstad spoke on the importance of raising the level of awareness of the values associated with geology and their link to national pride. Lars emphasised that it was important to recognise that geoheritage was diverse in scope and scale, ranging in size from minerals and fossils to landscapes. In addition, there were different levels of significance attributed to geoheritage. For example, there were geological attributes that gave a site national significance, such as the Silurian rocks associated with the fjords in Norway. However, glacial erratics, which were common throughout Norway and not valued because

they are commonplace, need to be conserved as a component of the geological history that give the area its geological significance.

José Brilha gave a global overview on the goals and objectives of geoparks. China currently has 140 national geoparks and 36 global network geoparks. José emphasised that it was important to have a national agenda for geoparks, and stressed the importance of local support. One advantage of a geopark is that it is not a protected area, so it does not carry some of the constraints of a designated protected area. Comments made included the fact that geoparks are important in community-building, and are also an important resource as an outdoor classroom for school children.

Kevin Page spoke on the challenges in the conservation of paleontological heritage and the importance of addressing the loss or damage to our fossil sites used for science and education. Fossil sites are used as a tourist destination, for science and education and for collection and sale. Kevin also spoke on the importance of the relationship between scientifically informed geoconservation based on the compilation of systematic inventories. These inventories inform the selection of representative, legally protected conservation sites and a 'parallel' development of geo-educational and geo-touristic facilities in the form of geoparks (*sensu largo*) and museum-based initiatives. A more comprehensive account of the event will be published by ProGEO in the near future.



Group photograph of some of the attendees at the GSA Session. Image courtesy Margaret Brocx.

International news

On 11 September, members from the Geological Society of Spain were successful in their motion at the IUCN Congress in Korea for geoheritage to be formally included in the *IUCN Program 2013–2016*. This historic event marks the first time that an IUCN Congress Forum will address geoconservation as an action taken towards the formal management and conservation of geodiversity and geoheritage – that is, the non-biological side of our natural diversity!

News from the Geotourism Subcommittee

New members

The Subcommittee has recently welcomed to its ranks three new members: Bruce Leaver, Chairman, Sapphire Coast Tourism, Cobargo, NSW; Professor Ross Dowling, Foundation Professor and Head of Tourism, School of Marketing, Tourism & Leisure of Edith Cowan University, and Ian Lewis, Director, Kanawinka Geopark, Mt Gambier – The Subcommittee records with appreciation the past contribution of Dr Nancy Vickery of the University of New England in Armidale who has recently resigned from the Subcommittee. A full Geotourism Subcommittee report, which covers the 34th IGC, recent developments with Kanawinka Geopark, and further engagement with the Australian National Landscapes Program, can be found at the GSA website Geotourism <http://gsa.org.au/heritage/Geotourism.html>.

MARGARET BROCX

Convenor

Standing Committee for Geological Heritage
geoheritage@iinet.net.au

ACT

National Science Week Event

Although many members were at IGC, the ACT Division once again ran a stall at the CSIRO 'Experimentathon' weekend in August, repeating last year's very successful dinosaur footprint painting devised by local committee member, Éva Papp. All weekend, Australian National University (ANU) undergraduates and Honours students led by Snowy Haiblen slaved away making plaster casts of crinoids, trilobites,

Children concentrate on their fossil painting at the CSIRO Science Week Experimentathon. Image courtesy John Rogers.



Quizine

BY TOR MENTOR

(Answers on page 45.)

There are many geological and geoscience societies throughout the world that produce a journal or newsletter. Can you match the professional society with their journal or newsletter in the following lists?

Professional society

- 1 Geological Society of Sweden
- 2 Geological Society of London
- 3 Geological Society of America
- 4 Geological Association of Canada
- 5 American Association of Petroleum Geologists
- 6 Australian Society of Exploration Geophysicists

- 7 European Association of Geoscientists and Engineers
- 8 European Association of Geochemistry
- 9 Society for Sedimentary Geology
- 10 International Ichnological Association

Journal or newsletter

- 1 *Ichnos*
- 2 *Explorer*

- 3 *GFF*
- 4 *Preview*
- 5 *Palaaios*
- 6 *Geology*
- 7 *Chemical Geology*
- 8 *First Break*
- 9 *Geolog*
- 10 *Quarterly Journal of Engineering Geology and Hydrogeology*

brachiopods, sharks' teeth and yes, a dinosaur footprint (courtesy of Patricia Vickers-Rich). Innumerable (actually about 600) small children were swiftly covered with garbage bags to protect their clothes – much to the relief of their parents. Then the children, some more expertly than others, enthusiastically covered the casts with paint and delightedly carried them off home.

While the youngsters were busy painting the casts (and themselves!), Doug Finlayson and John Rogers sought to interest their parents and older children in the geology of the Canberra region. The *ACT Guidebook and Map*, created by the GSA's ACT Division, came in very handy.

Visitors heard about the rocks under their houses, learnt how to find the nearest (extinct) volcano and learnt about the risk of the local earthquakes. Many were intrigued to learn something of the geology of well-known landmarks like the State Circle Silurian unconformity and associated faults and the Lake George horst and graben. Some curiosity must have been aroused because there has been a small but noticeable rise in the sales of our *Guidebook and Map*, so we can hope we have also recruited some future geologists.

JOHN ROGERS

QUEENSLAND

Ekka 2012 Report

The GSA Queensland Division (GSAQ) and the Queensland Branch of the Australasian Institute of Geoscientists (AIG) hosted another booth display at the Brisbane Exhibition (known locally as 'the Ekka'). The joint booth is almost a tradition now, and is part of a continuing effort to increase public knowledge about planet Earth, geology and mining. This year the City of Brisbane was lucky to host the 34th International Geological Congress (IGC), adding pressure on the Ekka event since the display needed to be up and running while the 34th IGC was still in full swing.

Even though members were busy working for and attending the 34th IGC, the support for this educational outreach to the public was very high. We had 18 volunteers and 11 sponsored students volunteering their time and passion to answer questions from the public. GSA Executive Director, Sue Fletcher,



Friedrich von Gnielinski, Laura Kaye and Alison Sternes at the 2012 Ekka display. Image courtesy Friedrich von Gnielinski.

was also able to spend a couple of valuable hours at the booth, obviously enjoying the questions posed by some very enthusiastic primary school students. On behalf of the AIG and GSAQ I would like to thank all the volunteers for their tireless efforts.

Even though we could not organise the display under the banner of National Science Week for the first time this year, we were still able to acquire a large space and run the same 'touch-and-feel' set-up of the large rock specimens, and show the large 'Careers in Geology' and the 'SE Queensland Evolution' posters. As well, we displayed the high-quality minerals, fossils and gems cabinet tower and the darkened cabinet demonstrating the fluorescence of various minerals and shells.

The changes to the exhibition grounds did not diminish the public's interest, with huge numbers of people attending on weekends and the public holiday. School days were a bit slower, although the booth's location within an education exhibition hall helped direct many school groups through our booth.

For the many kids who showed a genuine interest in rocks and minerals, we gave away

some bagged specimens (containing topaz, sapphire, magnesite, Ulam marble, chrysoprase, red agate or malachite), to the delight of the recipients. Most of these specimens were collected by me during fieldwork over the last two years with assistance from Renison Consolidated Mines, Kunwarara Mines, Gumigil Pty Ltd, Bajool Quarries and others.

One new attraction the Queensland Division of GSA could offer was the newly released booklet *Rocks and Landscapes of Brisbane and Ipswich*. This proved to be the hot seller at this year's display. A very pleasing total of around \$1560 worth of books were sold at the Ekka this year including \$640 alone on sales of the new Brisbane and Ipswich booklet.

At the time of writing, statistics including numbers of people through the pavilion were not available. The general feeling of volunteers, though, was that those numbers were again fairly high.

FRIEDRICH VON GNIELINSKI

Chair, 2012 Ekka Subcommittee
Queensland Division

SOUTH AUSTRALIA

South Australia committee member, Len Altman, has been awarded the 'Inspirational Teacher of the Year' for the Eastern Area at the South Australia Public Teaching Awards. The awards were held at the National Wine Centre of Australia in Adelaide. We would like to bring this outstanding award to the Society's attention, as Len has been a leading educator and member of the GSA.



Len Altman with his wife Peiming Chen at the South Australia Public Teaching Awards at the National Wine Centre of Australia in Adelaide. Image courtesy Len Altman.

WESTERN AUSTRALIA

We've had some great talks in the last few months, including John Bunting in October, who presented 'Hard-rock, soft-rock and the swinging monkey – a miscellany from the Perth Field Guide, and more'. The topic of his talk was his new field guide to outcrops around Perth, which was written very much for teachers of the new Earth and Environmental Sciences course, which is part of the WA Tertiary Entrance Exam (TEE). The GSA and Earth Science Western Australia (ESWA) supported this guide, and the first printing has already sold out. The talk was an excellent reminder of the great geology we have in our backyards, and a definite motivation to get out and see it.

We organised a joint GSA–AusIMM function in Kalgoorlie, at which Scott Halley, who is the 2012 Gibb Maitland Medal winner, spoke. Scott spoke on 'Geochemical and mineralogical footprints of hydrothermal systems based on ICP-MS and SWIR Data'.

The Society has also contributed to two field trips organised by Curtin University students. One was to the Boddington Mine, which was run by the West Australian School of Mines students' society. The other, run by the Applied Geology students' group (GEOS), visited a range of outcrops north of Perth. These included the Bells Rapids outcrop described by John Bunting in his field guide, which was a very timely addition to the trip.

We also co-organised, with a variety of other Perth geological societies, two events of broad geological interest. The first, led by The AusIMM, was a public lecture by Iain Stewart, who spoke on 'How to grow a planet'. The second, led by the International Association for Hydrogeological Sciences, was a talk by Pauline English on 'Groundwater investigations in paleovalleys in Western Australia – implications for the mining industry and the environment'.

In September our speaker was Phil Bland, who is the relatively new ARC Laureate Fellow based at Curtin University. Phil is developing the Desert Fireball Network, which uses a network of cameras on the Nullarbor Plain to spot and track meteorites. The tracking data enables his research group both to find the meteorites and to work out where in the solar system they came from. Knowledge of the composition and trajectory of the meteorites provides an unprecedented level of information on the composition and structure of the solar system. Phil spoke on 'Testing models of solar system formation and evolution by analysis of meteorites'.

KATY EVANS

WA Division

VICTORIA

The 2012 Selwyn Medallist — Charles Lawrence

Charles Lawrence has made major contributions to Victorian geology, including the development and formalisation of a stratigraphic framework for the geology of the Mallee of northwestern Victoria. This remains the basis for understanding and interpreting the geology and hydrogeology of the region and enabled the production of the geological map series of northern Victoria covering the Riverine Plain and the Mallee.

He has contributed to major hydrogeological research and has been successfully involved over many years in the development and advancement of the geological profession, initially in the Geological Survey of Victoria, and later in the teaching and supervision of research in hydrogeology at the University of Melbourne. This has included the organisation and delivery of professional hydrogeology courses and mentoring of a great number of young hydrogeologists. He has been involved in research and teaching of hydrogeology in Chile and Argentina through the overseas work of Geoscience Australia.

Charles Lawrence's hydrogeological research has covered a broad range of groundwater evaluation including the salinisation of the Murray Basin, groundwater contamination and desert studies in Australia, Argentina and Chile. He has collaborated with overseas organisations in Argentina and Mexico. He was the Chief Investigator in 2007 on the information and data exchange related to research into hydrogeology of the Otway Basin for the Corangamite Catchment Management Authority.

Charles Lawrence has made an important contribution into the long-neglected mapping, stratigraphy and economic potential of the Victorian side of the Murray Basin. At a time in which water resource management had hardly begun to understand the potential of ground-water resources, his work established the baseline references against which modern understanding of those resources is still premised today. He built on that work to become a national and international ambassador for water conservation. He was inspirational in leading to successive stages defining the long-misunderstood dynamics between surface and groundwater dynamics.

The Selwyn Medal

The Selwyn Medal is named in honour of Sir Alfred Selwyn, an eminent Victorian pioneering geologist and founder of the Geological Survey of Victoria. It is awarded, usually yearly, to recognise significant ongoing or former contributions of high calibre to any field of Victorian geology. A candidate for this medal should have made a major contribution to new knowledge of the geology of Victoria, or a significant reinterpretation of it based on critical observations; have contributed importantly to a major mineral or oil discovery; have produced important geological publications; or have been involved successfully in the development of the geological profession.

MATTHEW BLISS

Victorian Division



Ingrid Campbell, Chair of the GSA Victoria Awards Committee, with Charles Lawrence. Image courtesy Stephen Gallagher.

Coal Geology Group

Coal Geology Group at the 34th IGC

The GSA Coal Geology Group made its presence felt at the 34th International Geological Congress (IGC) in Brisbane, 5–10 August, with the surprise attendance of the explorer Ludwig Leichhardt at the booth. Lost for many years, he was tracked down by a member of the Canadian Mounted Police visiting with the Canadian contingent, and invited to attend the booth to celebrate his discovery, in 1845, of coal in the Bowen Basin (McKenzie River). [The accompanying photo does show a rather strong resemblance between Mr Leichhardt and Jim Beeston—Ed.]

Other famous discoveries of coal around Australia also featured. A highlight of the booth was the announcement of major publications now available for download at <http://www.cgg.gsa.org.au>.

The GSA Coal Geology Group also helped with the organisation of the International Committee for Coal and Organic Petrology (ICCP), which gave a short course the week before the IGC, featuring Professor Emeritus Claus Diessel and Dr Walter Pickel. There were 50 international and Australian participants, including about ten students. The course was hosted by CSIRO and the University of Queensland (UQ).

Wes Nichols, Past Chairman and committee member, ran a successful field trip on behalf of the GSA Coal Geology Group and the Bowen Basin Geologists Group to the Clarence Moreton Basin Jeebropilly coalmine. About 40 international and local people attended to view the highwall exposures of the Jurassic Walloon Coal Measures.

The IGC Coal Symposium, *Coal – a Myriad of Resources*, was well attended. There were two themes: 'Finding resources, making reserves' and 'Coal – a record of change'. Visitors included from Mozambique, South Africa, Russia, India, China, Hungary and the USA. There was a strong contingent of papers from Australia. An afternoon seminar dedicated to age dating, isotopes, palynostratigraphy and paleoclimatic changes in the Bowen Basin was headlined by Professor Ian Metcalfe from the University of New England (UNE), Armidale.

JIM BEESTON

Chair, Coal Geology Group



Jim Beeston

Jim started his geological career while attending Salisbury High School in the southern suburbs of Brisbane. He entered the University of Queensland, St Lucia, in 1967 and joined the Geological Survey of Queensland (GSQ) as a scholarship holder the following year. He graduated with a BSc in 1972, at the same time taking over the hands-on running of the Coal Petrology Laboratory of the GSQ Coal Section at Redbank.

Nine years later the Coal Group moved to Brisbane. By this time Jim had 20 published papers under his belt, largely to do with coal, including a major examination of coal rank variation in the Bowen Basin. This work stood the test of over 30 years of coal exploration in the Basin and gained him a Master of Science degree from the University of Queensland in 1981.

Fifteen years later he received an extension of responsibilities from coal to include basin studies and editing. During that time he produced a further 41 papers on coal, basin studies and paleobotany. In 1988 he published a major contribution to a study of the Denison Trough combining coal petrology, paleobotany and palynology with sedimentological observations.

An extension of this work was prepared and submitted to the University of Queensland as a submission for a Doctor of Philosophy degree. The thesis includes a re-look at aspects of coal deposition, and the origin of petroleum. Jim was awarded his PhD in 1998 and received the Zinc Corporation Prize for best thesis of the year.

Jim's editing responsibilities took over more and more of his time, particularly when combined with the duties involved in promoting and marketing the GSQ.

Jim is mostly known in geological circles for his establishment of the Geological Society of Australia Coal Geology Group in 1978 as Inaugural Chairman. His other titles include Honorary Editor of the group's journal *Australian Coal Geology* since 1986.

He has also been active in the Bowen Basin Geologists Group, editing and producing the *Bowen Basin Symposium Proceedings* volumes every five years over several decades.

In 2011 the Bowen Basin Geologists Group awarded him the Leichhardt Award, given to those who have made a lasting contribution to coal geology.

Jim retired in August 2011 but still retains an interest in coal geology and paleobotany. He currently holds the position of Chairman/Honorary Editor of the Coal Geology Group.

Jim Beeston, Chair of the Coal Geology Group, with the Canadian Mountie. Image courtesy Jim Beeston.

Earth Science History Group

Tom Vallance Medal award

The Earth Sciences History Group (ESHG) is pleased to announce that the inaugural award of the Tom Vallance Medal was made to Professor David Branagan during the 34th International Geological Congress (IGC). The presentation, which recognised David's outstanding contributions to the history of our science in Australia, was fittingly made at the start of the special symposium in his honour that opened the historical sessions of the IGC (Theme 33.1 – *Biographical studies of eminent geologists: a Symposium in honour of David Branagan*). It was also appropriate that the medal was presented to David by Tom Vallance's widow, Hilary, and that the ceremony was preceded by a short talk on the history and role of the ESHG by Bernie Joyce. Bernie had originally suggested the inauguration of this award. More details will be given in the ESHG's next newsletter.

INHIGEO field trip

Members will be aware that the 37th Annual Meeting of the International Commission on History of the Geological Sciences (INHIGEO) was held in Brisbane in conjunction with the IGC during August. A pre-conference field trip, planned and led by David Branagan with ESHG sponsorship, consisted of a transect from Sydney to Brisbane, visiting the Hunter Valley and the New England Foldbelt. According to David: "The excursion was treated to superb weather throughout, only the slightest touch of snow in New England, with plenty of local wildlife to interest the overseas contingent, and even a 'wild' koala in the trees at our last stop. We were blessed by two excellent drivers/organisers for the bus and backup vehicle, and by the ESHG sponsorship, which ensured our general insurance, but, which, thankfully we did not have to call upon."

The excursion guidebook is currently being edited and will probably be made available on the group's website. It will provide a useful resource for practising geologists, people involved in geological education and members of the public with an interest in historical matters.

JOHN BLOCKLEY



On day three of the INHIGEO pre-conference excursion, members were able to contemplate the granite at Moonbi Lookout, south of Armidale, NSW, on the edge of the New England Tableland. Image courtesy Barry Cooper.

In the news this issue

■ Earth Science Week and Triassic Park

■ International Earth Science Olympiad

Earth Science Week 2012 and Triassic Park

The tenth anniversary of the gazetting of Triassic Park, near Bacchus Marsh, by the Victorian Government under its *Crown Land (Reserves) Act, 1978* coincided with Earth Science Week 2012.

In 1873 a small reserve on the northern side of Bald Hill had been gazetted by the Victorian Colonial Government as a 'site whence stone may be procured'. In the 1890s plant fossil material was found in the small quarry opened to assess the quality of its sandstone. The fossils were deemed to be of Triassic age and over the following century more of the reserve was studied by Earth Scientists and students, often in conjunction with broader studies of the widespread Permian rocks and landforms of the Bacchus Marsh area. In 2000 the reserve was offered for sale by the Victorian Government as a location for residential development.

The offer of the reserve for sale was questioned by a small group of concerned Earth Scientists. Back in 1986 it had been declared to be of 'State' geological significance because it contained the only recorded outcrop of Triassic sedimentary rocks in Victoria. This primary information had been overlooked in the offer for sale. After two years of lobbying and negotiating with government, the sale offer was withdrawn, the 2.1-ha reserve was gazetted, and a six-member management committee was appointed in October 2002.

Ten years on, although Victoria had been devastated by drought for most of the decade, Triassic Park is in excellent condition. Management practices of ongoing rabbit and weed eradication have resulted in healthy growth of trees and understorey. Fencing defines the reserve and path construction makes access easier. Information signage assists visitors to interpret both the geology and the general environment they will see on their visit. Unwanted debris has been removed from the small quarry to better display its Triassic rocks.

The dedicated work of the committee of management, made up of both local citizens and Earth Science professionals, has pulled this historic reserve back from the brink of oblivion. It has made the site a showcase of success as a geological reserve for its Triassic outcrop. There is the added bonus of conserving a small area of bushland that has all but disappeared with urban growth in the vicinity.

As part of the Triassic Park committee's ongoing commitment to the local community, the authors of this article spent a day during Earth Science Week with Grade 4 children from the local Darley Primary School, introducing them to the varied rocks and fossils of the Bacchus Marsh area. The children participated enthusiastically and took away a fresh interest in the Earth Science of their area.

The Triassic Park Committee of Management members continue to maintain their involvement to conserve the Crown land reserve and ensure that it remains available for the wider community to visit and enjoy into the future.

SUSAN WHITE and ROGER PIERSON

Triassic sandstone cropping out in the small test quarry (the Council Trench) at Triassic Park. Image courtesy Roger Pierson.



International Earth Science Olympiad

On 8–12 October 2012, students from the Australian Science and Mathematics School at Flinders University, Adelaide, and the Yankalilla Area School in South Australia, competed in the 6th International Earth Science Olympiad (IESO) in Olavarría, Argentina, 2012. The 6th IESO was an opportunity for individuals with a passion for Earth Science from 17 countries to come together to share knowledge and ideas on the Earth Sciences.

This was only the second Australian team to participate in the IESO. Here we present a student perspective of attending this prestigious event.

The students who attended were Clara Tate and Darcy Cathro, both in Year 11 at the Australian Science and Mathematics School, and Maddi Mellow and Luke Bartlett from Yankalilla Area School. Accompanying them were mentors Dr Bronte Nicholls, Australian Science and Mathematics School and Mr Wally Pillen, Yankalilla Area School.

The trip's sponsors were the GSA Federal Division, Australian Society of Exploration Geophysicists, Petroleum Exploration Society of Australia, Beach Energy, Australian Institute of Geoscientists (AIG) – SA Branch, Resource and Engineering Skills Alliance and the Flinders University Centre for Science Education in the 21st Century.

Awards

The Australian team was very successful, winning several awards:

- Individual competition – Bronze Medal – **Luke Bartlett**
- Country team poster competition – 3rd prize – **Australian team**
- International Team Field Investigation (ITFI) – Most Cooperative
- Investigation winning team member – **Luke Bartlett**
- Honourable mention – Best solutions team member – **Clara Tate**.

Student perspectives

Preparing for the IESO was a joint effort by team members. A new event was added to the IESO this year – the poster competition, where students describe a site of geological significance in their country. Because we came from two different schools in different parts of South Australia, we first had to agree on a geological site to investigate. We settled on Hallett Cove, given the excellent evidence of Permian glaciation. Following a field trip to the site we worked on our poster over the next few weeks. We were very proud to have our poster win 3rd prize. Because we were not from the same school we had to do a lot of work on our own. Coming together as a team on the flight enabled us to clarify concepts and revise for the exams.

The following reports are our separate perspectives on the IESO and what it meant to us.

Darcy Cathro

As with the majority of our team, this was my first time overseas – matched with the unknown of the IESO, the trip seemed quite daunting. But within the first few days in Olavarría I couldn't understand why I had ever had doubts.

The first day's events included the opening ceremony. It was firstly a chance to see a little of each team as the flags were brought out. After taking this in, we were given a taste of Argentinian culture – through a tango dance and numerous songs by different bands and singers. This is when I began to really feel like I was overseas, seeing the change in scenery and ambience in the streets plus the different customs shown on stage. We also had a lecture from a planetary geologist. I found this very interesting particularly in the way two seemingly different areas of science could be linked, which I soon learnt is what the Olympiad aims to do and it really made me think differently about careers in these areas!

I was looking forward to the International Team Field Investigation (ITFI) and was pleased to be matched up with students from Kuwait, Ukraine, Spain, Italy and Germany – who all turned out to be great contributors. Following the field investigation I got a chance to speak to some Olavarrían high school students and learnt about them and their culture.

Hearing about other countries' preparation for the theory exams made me less confident. In the end I still felt reasonably pleased with the geosphere section because I had studied this at school. I had expected the practical components to be much more hands-on problem solving. Instead, most involved working out real-world examples using formulas, just like how I imagine a normal theory test – but nonetheless I felt that I had done a reasonable job in the geosphere section.

After each test we got the opportunity to go out on field trips with our mentors and our friends of the Olavarrían high school to a number of locations, including a rare red granite quarry, inside a ceramic tile factory and a site with interesting sedimentary structures, which included stromatolites. For me this was probably the most enjoyable component of the Olympiad as it blended all of my favourite experiences into a few trips. We got to bond with the local students constantly, while experiencing their culture, and also saw some amazing scientific sites which couldn't be seen anywhere else in the world.

After the Olympiad we moved on to Iguazú to experience even more of what Argentina had to offer. It was a good chance to reflect on all I had learnt and experienced in the previous week. In addition, we visited an amethyst mine, observed basalt flows and I saw my first Wonder of the World, Iguazú Falls, which was one of my most amazing experiences of all time.

So throughout the 14 days we spent in Argentina I was learning on a number of levels. Whether it was about safe travelling, food or the local economic-political situation, it also felt like I learnt a lot about myself. The biggest learning curve came in the area of Earth Sciences. Spending time with university mentors and teachers who study and teach Earth Sciences, and with students who wanted to study Earth Sciences, really gave me a new perspective on this career path. I now look at it as an area that gives fresh opportunities to work with wonderful people and explore the world.

Maddi Mellow

I learnt a lot about geology during the trip. Going on the field trips around Argentina developed my understanding of geological phenomena and how humans interact with and affect natural systems. I found the exams very difficult because I had to learn most of the astronomy/hydrosphere and atmosphere components through extra study in my own time. I found the geosphere component less difficult because I study geoscience at school as a Year 11 subject. I learnt many new concepts through completing the exams and studying with my peers.

Participation in the IESO has changed me in many positive ways. I have developed a deeper interest in Earth Science, my confidence has improved and my understanding of other cultures has broadened. Most importantly, I have made many new friends from all around the world.

After the Olympiad, Team Australia travelled to Iguazú. We were able to study the flood basalts at the Iguazú Falls and have a close look at the Wanda amethyst mine, where the amethyst is strangely present in basalt. At each location we had a tour guide who helped us learn more about the place and definitely helped improve our Spanish!



The Australian team departing Adelaide Airport. L-R Bronte Nicholls, Clara Tate, Maddi Mellow, Luke Bartlett, Darcy Cathro and Wally Pillen. Image courtesy Helen Pillen.



Local teachers and mentors observing flood damage along the Tapalque River, Olavarría, Argentina, site of the ITFI. Image courtesy Sabine Seidl.



LEFT: Ready for the IESO closing ceremony, Olavarría, Argentina. L-R: Darcy Cathro, Luke Bartlett, Maddi Mellow and Clara Tate. Image courtesy Wally Pillen.

BELOW: Visit to Wanda Amethyst Mine – Misiones Province, Argentina. Image courtesy Wally Pillen.



Luke Bartlett

The 2012 IESO has been a life-changing experience for me. I have made many new connections from all over the world and have friends in places that I never thought that I would.

Throughout the week we had a series of exams and practical tests designed to test our knowledge of the geosphere, hydrosphere, atmosphere and astronomy. I found the atmosphere and astronomy very difficult as I had not had much experience in these fields. I feel that my best topic was the geosphere as I am currently studying Year 12 geology.

The most memorable moment of the Olympiad was definitely working in the ITFI. I am used to working in a team because I play sports and so I assumed a lead role in the team. I was appointed leader of our group because English is my first language. My group won the International Cooperation Award, which we were ecstatic about. My group included students from Romania, Germany, Japan, Taiwan and the Ukraine.

Before the Olympiad I wanted to be a civil or structural engineer. In these fields you need to have an understanding of geology. The Olympiad has helped me gain experience with dealing with people from all around the world and may enable me to be able to travel with my future job.

Clara Tate

Our first major activity was the ITFI. We were put into mixed groups to investigate the effects humans have had on the Tapalque River that flows through Olavarría. We took photos, and made observations and notes about how the recent heavy flows and flooding had caused massive erosion along the riverbanks. There were sewer pipes leading into the rivers plus chemicals and rubbish entering the river from a nearby factory. My role as the group leader was to help the students who didn't speak fluent English, particularly with their writing. When it came to write up our findings into a PowerPoint and speech presentation I had the task of writing the speech because English is my first language. In the ITFI we had to come up with solutions to the problems we observed. I used my past knowledge of measures to reduce bank erosion I had seen in Adelaide, so from these ideas came up with a sustainable way to control the river erosion. I was really pleased that our group received an honourable mention for these solutions. This task made me really think about global problems and different solutions. It was a great way to get to know how people treat and care about the Earth, as well as for getting to know people and making future connections and friends for life.

Besides the exams, the IESO was a great way to meet people who share a common interest and I gained so much more knowledge than I started with – more than I would have learnt from school alone. I learnt many different things about other cultures and the field trips to mines and factories provided me with a once-in-a-lifetime experience.

Overall, I think being a participant of the IESO was a good experience and I was able to learn a lot from it. We learnt how to communicate and interact with people of many nationalities, religious and cultural backgrounds and languages while exploring, developing and presenting ideas to achieve a common goal. Many of the presentation, cultural and Earth Science skills I have learnt will help me in future studies at school and beyond.

CLARA TATE, DARCY CATHRO, MADDI MELLOW AND LUKE BARTLETT

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Young Earth Science News

Top young Earth Scientists

In this issue of *TAG*, we interview a young Earth Scientist, Michelle Cooper, from Geoscience Australia.

Michelle Cooper Geoscience Australia

TAG: What sparked off your interest in Earth Science?

MC: As a young child I used to smash open the quartz pebbles from the rock garden between my home and the neighbour's house; I loved how sparkly they were on the inside! I also grew up being fascinated by natural hazards, particularly earthquakes and volcanoes. When I was 10 years old someone gave me a postcard with before-and-after photos of Mount St Helens and I was captivated by it.

TAG: Who or what has influenced the direction of your career/research?

MC: Immediately prior to commencing a science degree at the University of Melbourne I attended a series of short presentations for each of the science subjects on offer and was inspired by the dynamic presentation given by Prof Ian Plimer, who continued to entertain throughout my degree. I loved hydrogeology and completed Honours in that subject supervised by Tamie Weaver. After completing my degree I moved to the UK and spent four years travelling and working as a restaurant manager and travel agent. While in the UK I received a call from JCU [James Cook University] inviting me to study for a PhD in sedimentology – they tracked me down through the free GSA membership I had received as an Honours student! I successfully applied for the Geoscience Australia graduate program six years ago and the wide range of projects has meant that I have been able to try my hand in a few subject areas and not get bored.

TAG: Where was your best field trip experience and why?

MC: I loved my third-year field trip to Tasmania's west coast. The landscape was spectacular and it was my first time going underground; I remember feeling like a 'real'

geologist. But some of my fondest field trip memories are of sitting in a small boat in the middle of my PhD field area, Lake Dalrymple in northern Queensland, eating a sandwich while collecting water quality data and pumping turbid water into sample bottles.

TAG: In a few words describe your career/research area.

MC: I work at Geoscience Australia in Canberra and I love the flexibility and range of things I get to work on. I'm currently based 50% of my time in the Mineral Exploration Promotion section where I work to promote Australia as an attractive destination for exploration and investment. I enjoy this role as it provides me with the opportunity to meet people with hugely diverse interests and backgrounds. The other half of my time is spent working with a small team to create a mafic-ultramafic magmatic event map of the Phanerozoic. These rock types are often associated with magmatic ore deposits (chromium, nickel, copper and platinum group elements) so the map and related dataset will be an important product for explorers and investors.

TAG: Where would you like to go with Earth Science in the future? What's your dream job?

MC: I don't really have a dream job but if I did it would have to involve travel of some sort. I love to work on a variety of different things and I'm lucky that my current job gives me the opportunity to do just that. I'm also passionate about promoting Earth Science to a wide audience so a dream job would see me interacting with people and hopefully inspiring them to learn more about geosciences.

TAG: How or why is Earth Science important to society?

MC: Earth Science is important to society in many ways. Understanding how the Earth works at all levels (tectonics, geomorphology, mineral systems, natural hazards – the list goes on) is fundamental to almost all aspects of human life. Knowledge of soils and climate is imperative to making sure that we have enough to eat. Water management is hugely important and the role of groundwater systems is often poorly understood. Mineral resources are required to build infrastructure

and manufacture products we use on a daily basis. Research into alternative energy sources relies on a comprehensive understanding of Earth processes, and knowledge of natural hazards is used to save lives, increasing people's awareness of the risk presented by different hazards in different areas.

TAG: Got anything else to say? Here's your chance!

MC: I am a member of the YES Network, an international network of young and early career Earth Scientists from around the world. Formed in 2009 as a Year of Planet Earth initiative, the network has grown to over 2500 members in only a few years. The second World YES Congress was held recently in Brisbane in conjunction with the 34th IGC. It's free to join and a great way to broaden your international network and increase your awareness of the broad range of Earth Science issues affecting communities all over the world! [Visit <http://www.networkyes.org>]



Taking a break beside the Yarra River at Warrandyte, Victoria. Image courtesy Michelle Cooper.

Recognition

GSA Fellows

John Cann

Geological career and profile

In 1937, John Cann was born at The Rock, a little-known town in New South Wales. How many geologists could claim such an auspicious start in life? He showed an early economic interest in rocks and minerals: quartz crystals he collected from mullock around mine shafts at Forbes were identified as diamonds and offered for sale to relatives, and chalcopyrite he found at Cloncurry was thought to be gold.

John's formal geological education began in 1956 at the University of New England where he studied to become a secondary school science teacher. Geology was selected initially as a fourth subject, after physics, chemistry and mathematics. However, under the tuition of people such as Alan Voisey, Ken Campbell, John Wilkinson and Keith Crook he soon developed a lasting passion for the Earth Sciences and went on to a double major in geology for his BSc. During those undergraduate years he developed and maintained a conviction that geology should have an equivalent place and status with the other more traditional sciences in Australian secondary schools. In NSW, geology was available as a senior secondary science subject, although it was taught in only a small number of Sydney schools, and there was no Earth Science in the syllabus for junior classes.

This was an interesting time in technology and science education. When Russia successfully launched its Sputnik satellite in October 1957, the USA and much of the rest of the world responded with a sense of competitive urgency. School-based science education in the USA, the UK and subsequently Australia received priority funding and new curricula were developed. At this time a major review of NSW secondary education, including science education, was underway. In his DipEd thesis (1959), John Cann proposed a case for the inclusion of geology in the NSW junior secondary science program, a case that was then successfully argued by Alan Voisey.

John's career in science teaching began in 1960 at Canberra Grammar School. In his second year of teaching he introduced geology as a senior science subject, and as the restructured four-year School Certificate



*John Cann.
Courtesy University of South Australia.*

program was phased into NSW and ACT secondary schools, he was given the task of preparing a science curriculum in which geology enjoyed an equal place with physics, chemistry and biology. Moreover, at that time he was the only science teacher in Canberra who had formal qualifications in geology, so he found himself playing a pivotal role as mentor in the ACT Science Teachers Association. Other schools adopted his curriculum: he ran workshops for teachers, led field trips to interesting geological localities in the Canberra district and assisted teachers to collect suitable geological materials for teaching. Subsequently, although still very early in his career, John was promoted to take charge of the Science Department at Canberra Grammar School. He remained in this role until 1968, overseeing the introduction of the science components of the Higher School Certificate. This included the transition of senior secondary school geology from the former Leaving Certificate syllabus, which assumed no prior knowledge of the subject, to the new program following four years of general science, including the fundamentals of geology.

During 1969–1970 John and his young family lived in Nauru where he had been appointed Principal of the Nauru Secondary School. This was an interesting time for him, both personally and professionally, but he did not easily accommodate the reality of the separation from classroom teaching that accompanies school administration. This fact, together with a difficult bureaucracy, convinced him to reconsider his career options. However, it was

in Nauru that he first developed his long-term and continuing interest in coral reefs, carbonates and phosphates.

In 1971 John was appointed foundation Lecturer in Geology at Salisbury Teachers College (an institution that underwent subsequent changes of name and status, and underwent amalgamations to eventually become part of the University of South Australia). So, as he had done before in Canberra, he set about developing study areas for geological field trips, and collecting and preparing materials for laboratory classes. Jim Gehling, then a Lecturer in Science at another metropolitan teachers college, and Colin Branch, then Head of the Applied Geology Department at the South Australian Institute of Technology, were particularly helpful. William ('Haggis') Shackleton was appointed, and he and John developed a field mapping camp at Oraparinna in the Flinders Ranges. This became a flagship activity for the department. In the following years, similar field activities were developed for areas of older rocks in the Olary–Broken Hill area, and younger rocks of southeastern South Australia and western Victoria. Additional excursions on long weekends complemented the field program. At this time Australia was enjoying a mineral resources boom and there was much interest in geology and geological education. Student numbers increased rapidly in a four-year program and an expanded Earth Science Department was established to meet the demand. Additional geology courses were developed for students (other than teacher trainees) who had a focus in environmental management, such as National Park Rangers. However, the Salisbury staff never lost sight of the fact that they were primarily preparing their students to become teachers of geology, an educational focus that received general recognition in the wider Australian geological community. This focus culminated in the Australian Earth Science textbook *Perspectives of the Earth*, edited by Ian Clark and Barry Cook, and published by the Australian Academy of Science. Subsequently, 'Haggis' Shackleton became Head of Department as John took charge of the mathematics and science secondary teacher education degree program. This was initially a four-year concurrent BEd, but later, as amalgamations of institutions were underway to form the University of South Australia, the program was reaccredited as



University of South Australia Coastal Environments students closely studying the characteristics of the tidal-dominated sediment at Port Gawler, SA, while John Cann looks on. Image courtesy Solomon Buckman, University of Wollongong.

a combined concurrent BSc and DipEd. Academic courses within the BSc would be taught on multiple campuses by staff who had previously operated independently of one another. John oversaw the sometimes lengthy negotiations and the final implementation of the BSc/DipEd.

John's entry to academic research began relatively late in life. In the early 1970s he studied an assemblage of late Pleistocene molluscan fossils that had been excavated from a coastal site near Salisbury, and recognised several species (such as the Shark Bay pearl oyster) of tropical affinity. Thus he learnt of the 'last interglacial', which stimulated his interest in past climates and sea levels. At Adelaide University, Brian McGowran persuaded him that foraminifera have greater potential value than molluscs as environmental proxies, and so John enrolled in a PhD with Brian as supervisor, exploring the distribution of benthic foraminifera in the South Australian gulfs and adjacent continental shelf, and the fossil equivalents of these same species in Quaternary marine sediments. As this work progressed, influential research colleagues included Tony Belperio, Patrick De Deckker, Victor Gostin and Colin Murray-Wallace, all of whom made valuable contributions to his professional development.

In the rationalisation of staff and campuses that followed the formation of the University of South Australia, John (now Associate Professor) joined the Applied Geology staff at The Levels campus (subsequently renamed Mawson Lakes). In 1997, with further rationalisation of staff numbers, John

accepted early official retirement, but remained as an adjunct, teaching in his areas of specialisation and supervising student research. He was thus able to devote more time to research and consulting.

During 1999–2001 John accompanied his wife, Elizabeth Elliot, to Baltimore, Maryland, USA, where she had a post-doctoral research position with the National Institute of Drug Abuse. For that time John was a visiting academic at the Department of Earth and Planetary Sciences of Johns Hopkins University, where he taught aspects of his research interests to both undergraduate and graduate classes. He also gave seminars at several American universities and worked jointly with researchers from the US Geological Survey on postglacial sedimentation in Chesapeake Bay. His close associations with Steven Stanley



John explaining the bioclastic content of sediment in a lake adjacent to the Coorong, SA at the AQUA field trip in 2008. The field trip was run jointly by Patrick De Deckker and John Cann. Image courtesy Patrick De Deckker.

(paleontologist) and Lawrence Hardie (carbonates and evaporites) at Johns Hopkins were particularly rewarding.

For the past decade John has been Adjunct Professor (Geology) in the School of Natural and Built Environments at the University of South Australia. During much of that time he has coordinated and taught, mostly with his colleague Jim Jago, the 'Coastal Environments' summer course. Students from various backgrounds learn about coastal processes, the record of paleo-sea levels and selected marine invertebrates, among other topics. John brings to this course his own observations of tidal-dominated environments such as Shark Bay in WA, and Pacific Islands such as Kiribati. He has derived great personal and professional satisfaction from delivering this very popular course.

John has been chairman and secretary of the SA Division of the GSA and remains particularly active in the Divisional Field Guides Subcommittee: he is the principal author of the field guide to the geology of the Coorong Lagoon and adjacent environments (available for download from the GSA website). He was the 2007 recipient of the Bruce Webb Medal. This year he initiated a project in which he has invited geologists to send him 35-mm colour transparencies, featuring geological content, for digital processing. He anticipates that this project might take up to three years, during which time he aims to compile sets of images that will be freely available to educators on the GSA website. Six years ago John was diagnosed with Parkinson's disease, but the disease has progressed slowly and he has so far managed to maintain his enthusiasm for his busy professional life.

Postscript — John was made a Fellow of the Geological Society of Australia in 1997.

JOHN CANN

Colin Ward

Geological career and profile

Colin Ward has been elected as a Fellow of the Geological Society of Australia for his contributions to research in the geosciences, in particular coal geology; his contributions to the education and training of geoscientists; and his contributions to the Society. Ian Graham and Paul Lennox prepared the nomination.

Colin Ward graduated with a University Medal in Applied Geology from the University of New South Wales (UNSW) in 1967, and obtained his PhD from the same university in 1971. His undergraduate studies were supported by a scholarship from the Joint Coal Board, and included vacation work involved in different aspects of coal exploration and mine geology. Although his Honours thesis involved mapping the Proterozoic and Devonian strata at Fowlers Gap, north of Broken Hill, and his PhD was on fluvial sedimentology of the Triassic sequence in the southern Sydney Basin, the scholarship and vacation work provided the springboard for much of his subsequent academic career.

After completing his PhD, Colin joined the academic staff of the New South Wales Institute of Technology (now the University of Technology, Sydney), with responsibility for setting up a teaching program in sedimentary geology and related fields. This included an undergraduate program in coal geology, which was extended in 1977 to become an external short course for graduates working in the coal industry. The graduate-level course has evolved over the years, and Colin still provides programs in different aspects of coal geology for companies and other organisations throughout the world. In collaboration with other industry and academic colleagues, he also developed an internationally recognised textbook, *Coal Geology and Coal Technology*, which was published by Blackwell Scientific in 1984 and remains a useful reference at the national and international level.

Drawing on knowledge of clay mineralogy inherited from his PhD supervisor, Fred Loughnan, Colin also began research programs to investigate mineral matter within coals. He further developed this research while on study leave at the Illinois State Geological Survey in 1975. He also spent six months with the Sydney-based consulting group of McElroy Bryan and Associates in 1979, working on a range of coal resource evaluations. This was followed by a second period of study leave at the University of Kentucky in 1980, supported by a Fulbright Travel Award.



Colin Ward. Image courtesy Colin Ward.

Colin returned to UNSW in 1984, taking up a position vacated by Fred Loughnan's retirement. This allowed him a greater focus on research activities, including more in-depth work on mineral matter in coal, investigation of methane ignition by rock friction in underground coalmines, and regional studies on different aspects of the Sydney, Gunnedah and Bowen Basins. In conjunction with colleagues from other institutions, he was also involved in compiling a *Photographic Guide to Cored Rocks of the Sydney Basin* (University of Sydney, 1986), *Geology of Australian Coal Basins* (GSA Coal Geology Group, 1995) and *Geology in Longwall Mining* (Coalfield Geology Council of NSW, 1996).

Following promotion to Associate Professor, Colin became Head of the Department of Applied Geology at UNSW in 1993. He served in that role during a tumultuous period of change at the University until the end of 2001, when geology merged with other disciplines to form the School of Biological, Earth and Environmental Sciences.

Colin's research program was strengthened by study leave in 1998 at CSIRO and the University of Sheffield, with a focus on developing X-ray diffraction as a quantitative tool for mineralogical evaluation. He has published over 100 refereed papers on his various research projects, and a similar number of full-length papers at national and international conferences. Colin has served as

a member of the Editorial Board for the *International Journal of Coal Geology* since 1990, and in 2012 was Guest Editor for a Special Issue of that journal on Minerals and Trace Elements in Coal. He has also served as Project Leader in the CRC for Coal in Sustainable Development, working on coal ash characterisation, and as a technical member of the NSW Coal Compensation Review Tribunal.

Colin retired as Professor of Geology at UNSW in July 2006, but continues as a Visiting Professorial Fellow at the university and as a Visiting Scientist with CSIRO Division of Energy Technology. In 2010 he was presented with the Gilbert H Cady Award for Coal Research by the Geological Society of America, becoming the first Australian coal geologist to be recognised in this way. He has also received the Award for Excellence in Coal Geology from the Coalfield Geology Council of NSW (1998), and the Ralph J Gray Award for the best refereed paper in organic petrology from the Society for Organic Petrology (2011). Other honours include presentation of the Kenneth Mosher Memorial Lecture in 2000 and the JJ Frankel Memorial Lecture in 2007.

Colin served as Chairman of GSA's Coal Geology Group in the early years of its formation (1979–1981), and also as Secretary of the New South Wales Division (1983–1984). In addition, he has served as Chairman of the Coalfield Geology Council of NSW (1985–1987), as Councillor for the Australian Institute of Geoscientists (1991–2000) and as President of The Society for Organic Petrology (2004–2005). He is a Fellow of the Australasian Institute of Mining and Metallurgy, the Australian Institute of Geoscientists and the Geological Society of America. In 2012 he was presented with the John Castaño Honorary Member Award from the Society for Organic Petrology, recognising his exemplary commitment to education, excellence in research and service to that society and to the wider geological community.

Throughout his career in academia, Colin has taught numerous students in Australia and overseas at both undergraduate and post-graduate levels. Many of these people are now at senior levels within industry, research institutions and universities.

IAN GRAHAM

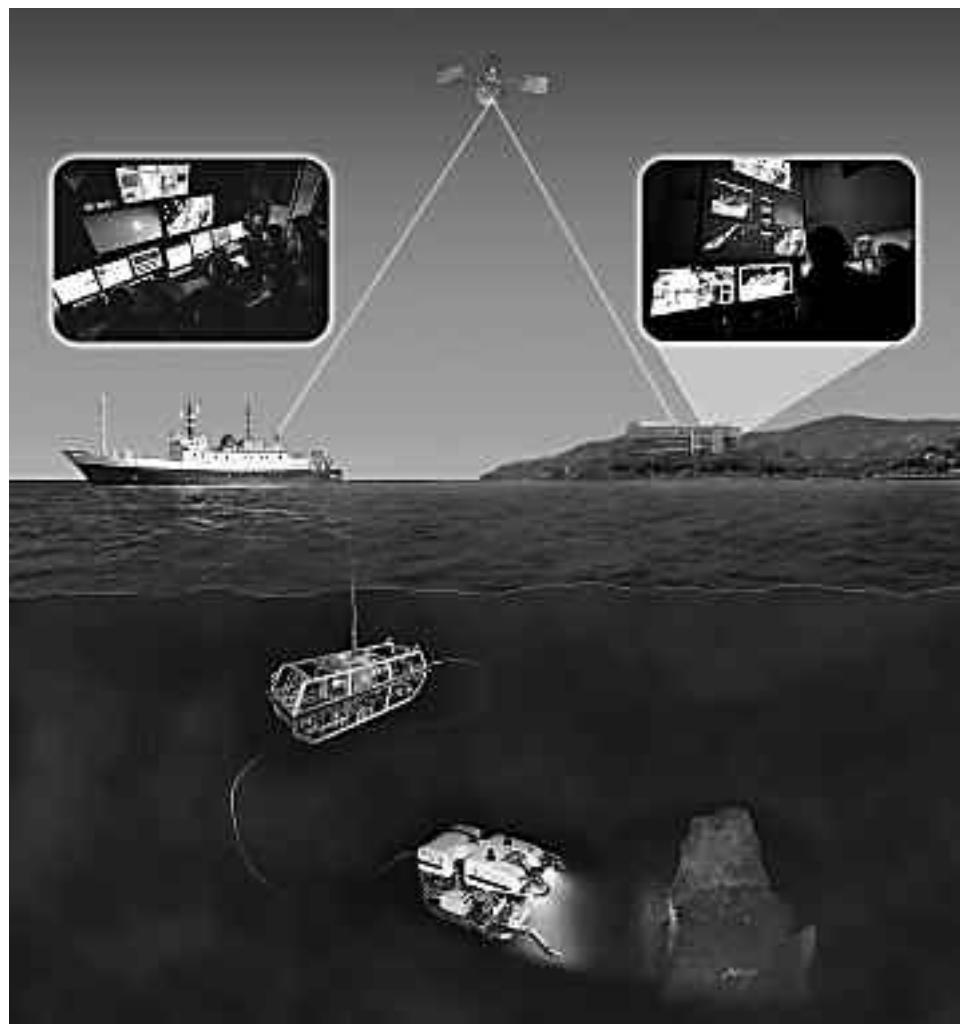
Feature

Nautilus Exploration Program — high-resolution robotic mapping of deep-sea sites

The Nautilus Exploration Program aims to explore the ocean, share discoveries in real time through remote telepresence technologies, and engage and educate vast audiences about the unknown ocean. This program operates under the direction of Dr Robert Ballard, the discoverer of the remains of RMS *Titanic* and other scientifically significant deep-sea sites such as hydrothermal vent systems. The program is built on technologies and methodologies developed during the past decade and put into full implementation during the past four field seasons in the Mediterranean Sea and Black Sea on-board E/V (exploration vessel) *Nautilus*. The ship and its complement of deep-submergence vehicle systems for mapping, exploring and sampling the sea-floor are the centrepiece of broad-based scientific and educational programs involving a multitude of partnerships. Among the partners are the Ocean Exploration Trust, the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean Exploration and Research, the University of Rhode Island Graduate School of Oceanography (URI-GSO), Mystic Aquarium in Connecticut, the Jason Project based at Mystic, the Inner Space Center based at URI-GSO and the National Geographic Society.

The primary goal of the Nautilus Exploration Program is to use its 'corps of exploration' as a model for science, technology, engineering and mathematics (STEM)-based education that involves exploration, discovery,

educational engagement and real-time remote participation via live video streaming to an interactive website. Vast audiences can participate and ask questions about the science and exploration operations at <http://www.nautiluslive.org>. The Oceanography Society published a summary of recent Nautilus programs as a supplement to *Oceanography* magazine in 2012 (http://www.tos.org/oceanography/archive/25_1_supplement.html). The E/V *Nautilus* will continue its exploration program in 2013 in the Caribbean Sea and beginning in 2014 will move into the Pacific Ocean toward the unexplored waters off Australia and New Zealand.



Graphic illustrating the Nautilus Program technology. Remotely operated vehicles (ROVs) including Argus and Hercules are connected to the surface ship E/V Nautilus, where the ROV control systems are connected to shore via high-bandwidth satellite internet, to enable real-time streaming of the discoveries and remote participation by scientists, students and the public onshore. Image courtesy Dwight Coleman.

This article summarises some recent work conducted as part of the 2011 and 2012 E/V *Nautilus* programs in the Aegean Sea and Black Sea off the coast of Turkey, where many ancient shipwrecks were discovered. Also summarised are dives off the coast of Italy, where several active underwater volcanoes and their hydrothermal systems were investigated.

The program's remotely operated vehicle (ROV) systems include *Hercules* and *Argus*. The ROVs are controlled on-board the ship by engineers and technicians who stand watches around the clock and communicate with scientists both on-board and ashore through the telepresence system (high-bandwidth satellite internet). The ROVs are equipped with a suite of mapping instruments for detailed visual and acoustic sea-floor surveys.

Mapping is a central research focus of the program, and a key component to the documentation and exploration of deep-sea geological, biological and archaeological sites. The techniques to collect and process the visual and acoustic data into high-resolution maps are continuously being developed and refined to achieve better accuracy over larger scales. The academic part of this effort is based at URI-GSO and includes a partnership with the Australian Centre for Field Robotics (ACFR) at the University of Sydney. Researchers at the ACFR have collaborated with Nautilus Program partners on-board the ship, assisted with the deployment of ROV mapping systems and refined the data collection, processing and visualisation methodologies. Graduate students in Ocean Engineering at URI are working closely with ACFR students and researchers to further our ability to digitally document the sea-floor.


The mapping sensors on *Hercules* include a 1350-kHz BlueView Technologies multibeam sonar, colour and black and white 12-bit 1360 × 1024 Prosilica stereo cameras, and a 100-mW, 532-nm green laser structured light system. These sensors are mounted on the rear of the ROV and arranged to image a

common footprint under the vehicle. ROV navigation data are collected by an RDI Doppler velocity log (DVL), an IXSEA OCTANS fibre-optic gyroscope and a Paroscientific depth sensor. Precise navigation is a key component to the mapping process, as every mapped segment of the sea-floor depends on a detailed measurement of the three-dimensional position (latitude, longitude, depth) and attitude (pitch, roll, yaw) of the ROV.

In general, all mapping systems on the ROV (sonar, structured light and photographic) can collect data simultaneously, although only certain systems are optimal for different sea-floor conditions or survey parameters. For example, turbid water can prevent visual photographic surveys from collecting usable images, so the sonar and structured light systems can be used instead. Another example is for high-altitude bathymetry mapping surveys of large areas where multibeam sonar data are more useful than photographs or laser data.

Surveys are designed for site-specific data collection and are structured in a grid pattern and optimised for a certain altitude and line spacing to provide complete overlapping coverage of the site. The ROV can be operated in a closed loop to hover at a specific altitude above the sea-floor and drive at very precise speeds and directions. All data are collected relative to the origin of the ROV survey, which can be synchronised to real-world positioning based on the absolute tracking of the ROV relative to the ship with an ultra short baseline (USBL) system.

Prior to ROV dives, sea-floor targets are usually identified by broader scale mapping techniques such as towed side-scan sonar surveys or hull-mounted multibeam sonar surveys. Scientists leading the exploration program use the mapping data and target information to prioritise ROV dive locations and ROV survey strategies. Targets identified by the scientists typically include sites of geological, biological or archaeological interest, as determined by the ship-based mapping process.



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Examples of archaeological sites include modern shipwrecks, ancient shipwrecks and inundated terrestrial sites of human occupation that now lie deep underwater due to post-glacial sea-level rise and crustal isostatic rebound.

Examples of biological sites include interesting habitat, reef structures for deep-water corals and other benthic organisms, seamounts, hydrothermal vent communities and cold seep or gas seep communities.

Examples of geological sites are the terrains associated with active underwater volcanism, deep faults and fissures, hydrothermal vent systems, mud volcanoes, gas hydrate formations and other types of sea-floor seeps.

Archaeological sites

Ancient shipwrecks represent sites of archaeological significance that preserve a snapshot of history. Often during our exploration we come across shipwrecks, both ancient and modern, and we document these discoveries to study their regional distribution, especially throughout the Mediterranean Sea and Black Sea. The image on the cover of this issue is the wreckage of a modern Greek merchant ship *M/S Dodekanisos*, which sank in a gale in 1958 while underway to the Greek island of Kos, located off the southwestern coast of Turkey. The ship landed on the seabed upright, listing slightly to starboard with its bow facing to the northwest (Brennan, in press). Using the BlueView multibeam sonar system on the ROV, we conducted a high-resolution mapping survey of the wreck at an altitude of 15 m above the sea-floor. Processing of the sonar data led to the creation of a microbathymetric grid, which was imported into the sonar data visualisation package QPS Fledermaus. This program allows the user to visualise and interact with 3D data to accurately portray the dimensions of the wreckage on the seabed.

The other image on the cover of this issue is from a portion of the stern section of the wreckage of *RMS Titanic*, which sank more than 100 years ago and was discovered by Robert Ballard in 1985. *Titanic* broke in half prior to sinking and the stern section floated for a while after the bow section sank. The bow section remains largely intact, but the stern section became heavily damaged during the breakup and subsequent sinking. This image shows heavily damaged debris that fell to the seabed on top of the stern section, which is also upright on the sea-floor. This rugged debris created some challenges for the ROV mapping systems and data processing workflow related to changes in illumination and scale. The data were collected in 2004 prior to obtaining the high-resolution mapping systems currently installed on *Hercules*. High-definition video camera still frames were processed and digitally stitched together to create a single composite photomosaic. This dataset has been used as part of a historical baseline of documentation for this site of the world's most famous shipwreck.

A digital photomosaic of an ancient shipwreck site from the southeastern Aegean Sea off the coast of southwest Turkey is also shown on this page. It was named *Knidos F* because of its proximity to the ancient port of Knidos, Turkey, and since it was the sixth shipwreck found in the region. The hull of the ship has deteriorated away or has been eaten by wood-boring organisms. All that remains visible is the cargo of hundreds of clay jars called amphorae (Brennan *et al*, 2012).

The amphorae were carrying commodities such as wine or olive oil that the ancient merchant mariners were trading and transporting from one port to another. The terrestrial archeological records include amphorae such as these and allow archeologists to know a great deal about them. By identifying the amphora type, the vintage and provenance of the ship's cargo can typically be determined. Also, since we generally know the sizes, shapes and dimensions of these containers, they represent an ideal way to calibrate and groundtruth the mapping data and techniques. It is often easier to identify errors in the maps that contain these common geometries than in completely natural and more complex terrain.



Amphorae from the *Knidos F*. Image courtesy Dwight Coleman.

The digital photomosaic image of the *Knidos F* was assembled by first processing and correcting the photographs for lighting and camera distortions. The ROV navigation data are then used to build a single composite 3D representation using the scene geometry derived from the image texture and stereovision techniques. The process is automated and implemented using software developed at the ACFR. Several hundred individual photographs were used to build this image.

High-resolution bathymetric maps

A high-resolution bathymetric map of the Palinuro Seamount compiled from the structured light laser data as shown on page 32. The structured light technique uses a camera to image the reflected light from a sheet laser that projects a visual line on the sea-floor. When the geometry between the laser and camera is known, the images can be processed to produce 2D slices of the bottom with millimetre-range resolution using triangulation. In 2012 we developed an *in situ* calibration procedure to determine the camera and laser geometry that can be used over natural terrain during normal operations. This approach uses feature points automatically extracted from stereo images of the laser line, and uses stereo projections to place these points in the three dimensions.

To survey complete shipwrecks, we use a previously developed bathymetric simultaneous localisation and mapping (SLAM) technique (Roman & Singh, 2007). This method relies on matching sections of the laser data across overlapping track lines to help reduce the negative effects of position drift in the ROV's dead-reckoned navigation. Our goal is to produce surveys of the order of a hundred metres per side, and at grid resolutions of 5 mm. The overall processing pipeline to make these maps in an automated fashion over complex scenes can be challenging and is a topic of ongoing research.

During the 2011 field season, *E/V Nautilus* explored four volcanic seamounts in the Aeolian Arc to document recent volcanic activity and evidence of hydrothermal venting. On Palinuro Seamount several volcanic edifices lie along an east-west trending fault system (Carey *et al*, 2012). Massive sulfide fragments were recovered from the western portion of the seamount during previous work. A *Hercules* ROV dive in this area revealed areas of fluids venting and associated colonies of living tubeworms and bacteria.

One of the ROV dives was dedicated to mapping this vent field with the laser system to produce the high-resolution bathymetric map. This map is a centimetre-scale resolution bathymetric dataset created to monitor change to the volcanic centre over time. Also, this map can be used for detailed navigation of the ROV to the sampling sites. In this area of high-temperature venting, honeycomb chimneys with interconnected spires are coated with brownish yellow bacteria and are likely constructed of iron-bearing minerals. The discovery of active venting at this site can explain the strong water-column chemical signals observed by previous conductivity, temperature and depth (CTD) surveys at the site.

Summary

In summary, the robotic mapping process has resulted in very detailed documentation of sea-floor discoveries including both modern and ancient shipwrecks, and hydrothermal vent structures associated with active underwater volcanic centres. As the *Nautilus* Program evolves and work continues in the Caribbean Sea and Pacific Ocean, we will improve the process and document new discoveries. We look forward to continued collaboration with the ACFR and to developing new collaborations with other Australian scientists and engineers. In this way we hope to broaden our reach to the western Pacific and share some new discoveries with audiences worldwide.

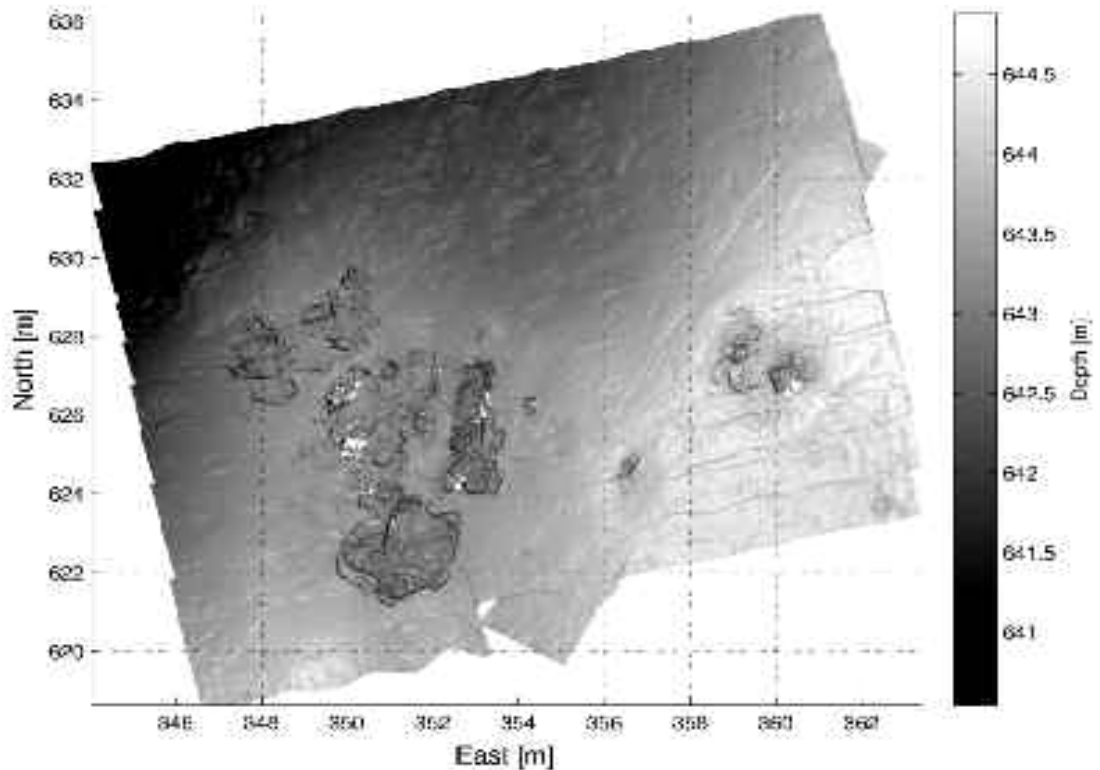
DWIGHT COLEMAN, CHRIS ROMAN, MICHAEL BRENNAN
and CLARA SMART

University of Rhode Island
Graduate School of Oceanography

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Palinuro Seamount



Microbathymetric map of a hydrothermal vent field on Palinuro Seamount, an active submarine volcano in the Tyrrhenian Sea, north of Sicily, part of the Aeolian Volcanic Arc. Depth data collected using structured light. Centimetre-scale map produced by processing photographs and measurements of reflections from a green laser sheet over the vent field. Image courtesy Dwight Coleman.

34th IGC – another Aussie success story

TAG has previously published information about the 34th International Geological Congress (IGC) but in this issue we want to acknowledge and thank the 34th IGC organisers and publish final information and reports from sponsored students.

Conferences come together because of the work of many people, but successful conferences are built on the strength of the participants. All participants and members of all committees contributed to making the IGC a successful event that the Australian geoscience community should be proud of. As well, the delegates who attended the IGC, the volunteers working at the IGC, exhibitors and sponsors all contributed to making the 34th IGC successful and truly unique – congratulations and thank you all!

Organiser — Australian Geoscience Council

The 34th IGC was the culmination of many years' work by many geoscientists working in different organisations. The IGC was made possible because of the huge effort key volunteers made (especially the Organising Committee!).

The Congress was organised by the Australian Geoscience Council (AGC), which is the peak council of geoscientists in Australia. It represents eight major Australian geoscientific societies with a total membership of over 7000 individuals comprising industry, government and academic professionals in the fields of geology, geophysics, geochemistry, mineral and petroleum exploration, environmental geoscience, hydrogeology and geological hazards.

34th IGC Organising Committee

The Organising Committee had oversight for all aspects of the IGC. Neil Williams, with his significant experience in leadership, was at the helm of the IGC in the role of President. Ian Lambert worked full-time on the IGC in the all-encompassing position of Secretary General. As well as the diverse responsibility Ian held as the IGC Secretary General, he was often promoting the IGC at conferences within Australia and overseas. Now, in Ian's new position of Secretary General of the International Union of Geological Sciences, he will promote Australian geosciences to the world.

Thank you to all members of the IGC Organising Committee:
President — Neil Williams, University of Wollongong
Secretary General — Ian Lambert, Geoscience Australia
Deputy Secretary General — Paul Kay, Geoscience Australia
Deputy Secretary General — Paulo Vasconcelos, University of Queensland
Scientific Program Chair — Lynton Jacques, Australian National University
Finance Committee Chair — Miriam Way, The AusIMM
Field Trips Committee Chair — David Mason, Geological Survey of Queensland
Sponsorship Committee Chair — Ashley Gordon, Carillon Conference Management

Committee Members

Mark Berry, Australian Institute of Geoscientists
Hamish Campbell, GNS Science (New Zealand)
David Denham, Australian Society of Exploration Geophysicists
Geoff Dickie, Queensland Resources Council
Maurie Drew, Petroleum Exploration Society of Australia
Jonathan Gordon, Carillon Conference Management
Michael Leggo, Australia Geoscience Council
Alex Malahoff, GNS Science (New Zealand)
Robert Murdoch, Consultant
Gabiella Perlingeiro, University of Queensland
Colin Simpson, International Union of Geological Sciences
Mike Smith, Australian Geoscience Council

Scientific Program Unearthing our Past and Future Resourcing Tomorrow

The scientific program was many years in the making and delivered an impressive 37 themes, as well as major forums. The themes reflected the crucial role geosciences play in meeting the needs of societies while sustaining the Earth. The Scientific Program Committee and the Scientific Theme Coordinators developed the conference themes with input from the International Union of Geological Sciences (IUGS), affiliated groups and individual scientists.

The panels and scientific and plenary presentations covered all areas of the geosciences. Delegates were impressed with the diversity and high quality of the program and speakers.



Many delegates enjoyed the ice-breaker. L-R: Steven Hill, University of Adelaide, Pauline English, Geoscience Australia, Millie Crowe, University of Adelaide and Katherine Stoaite, University of Adelaide.



The Hon Martin Ferguson, Minister for Resources and Energy, at the International Resource Ministers Forum.



Bruce Ainsworth, Adelaide School of Petroleum; Anna Petts, Flinders Mines; and Simon Holford, Adelaide School of Petroleum.



Ian Lambert and Neil Williams with a live exhibit.



Mr Nguyen Linh Ngoc, Vietnamese Vice Minister of Natural Resources and Environment, at the International Resource Ministers Forum.



Delegates enjoying the ice-breaker in the exhibition hall.

Photo courtesies: All images are supplied courtesy Carillon Conference Management Pty Ltd.

Scientific Program Committee

The Scientific Program Committee was led by Lynton Jacques. Thank you to Lynton and all the members of the committee and the many theme Coordinators:

Lynton Jacques, Committee Chair, Canberra, ACT

Mike Smith, Chair Australian Geoscience Council, Sydney, NSW

Ian Lambert, Secretary General 34th IGC, Canberra, ACT

Mike Archer, University of New South Wales, Sydney, NSW

Mark Berry, Australian Institute of Geoscientists, Brisbane, Queensland

David Denham, Australian Society of Exploration Geophysicists, Canberra, ACT

George Gibson, Geoscience Australia, Canberra, ACT

Andrew Gleadow, University of Melbourne, Melbourne, Victoria

David Lumley, University of Western Australia, Perth, WA

Alex Malahoff, Chief Executive, GNS Science, Lower Hutt, New Zealand

Colin Simpson, Councillor, IUGS, Canberra, ACT

Paulo Vasconcelos, University of Queensland, Brisbane, Queensland

Malcolm Walter, University of New South Wales, Sydney, NSW

Paul Kay, Deputy Secretary General 34th IGC, Canberra, ACT

Scientific Themes

Symposia, which were arranged under 37 themes, are summarised below along with the coordinator of each theme and his or her contact details. The other major forums are also summarised below.

Theme 1 – Geoscience for Society – Hamish Campbell
h.campbell@gns.cri.nz (New Zealand)

Theme 2 – Geoscience Benefiting Low Income Countries – Mike Katz mkekatz320@gmail.com (Australia), Shrikant Limaye (India), Afia Akhtar (Bangladesh) and Antony Reedman (UK)

Theme 3 – Climate Change: Lessons from the Past; Implications for the Future – Michael Bird michael.bird@jcu.edu.au (Australia) and Giuseppe Cortese (New Zealand)

Theme 4 – Environmental Geoscience – Colin Simpson simpsons@grapevine.com.au (Australia) and Michael Leggo (Australia)

Theme 5 – Geoscience Information – Bruce Simons bruce.simons@csiro.au (Australia), Simon Cox (Australia), Robert Tomas (Europe), Richard Hughes (UK), June Hill (Australia) and Lesley Wyborn (Australia)

Theme 6 – Energy in a Carbon Constrained World – Peter Cook pjcook@co2crc.com.au (Australia) and David Lumley (Australia)

Theme 7 – Mineral Resources and Mining – Graham Carr graham.carr@csiro.au (Australia) and Dale Sims (Australia)

Theme 8 – Mineral Exploration Geoscience – Cam McCuaig campbell.mccuaig@uwa.edu.au (Australia) and David Giles (Australia)

Theme 9 – Mineral Deposits and Ore Forming Processes – Ross Large ross.large@utas.edu.au (Australia) and Cornel De Ronde (New Zealand)

Theme 10 – Coal – a Myriad of Resources – Joan Esterle j.esterle@uq.edu.au (Australia)

Theme 11 – Petroleum Systems and Exploration – Marita Bradshaw marita.bradshaw@ga.gov.au (Australia), Chris Uruski (New Zealand) and Sylvia Anjos (Brazil)

Theme 12 – Unconventional Hydrocarbons – Emerging Fuels – James Underschultz james.underschultz@anlecrd.com.au (Australia) and Ingo Pecher (New Zealand)

Theme 13 – Sedimentation and Sedimentary Processes – Chris Fielding cfielding2@unlnotes.unl.edu (USA) and Peter McCabe (Australia)

Theme 14 – Basin Formation and Continental Margin Processes – George Gibson george.gibson@ga.gov.au (Australia) and Francois Roure (France) [International Lithosphere Program Task Force on Sedimentary Basins]

Theme 15 – A Dynamic Earth – Dietmar Müller dietmar.muller@sydney.edu.au (Australia)

Theme 16 – The Deep Earth – Sue O'Reilly sue.oreilly@mq.edu.au (Australia) and Bill Griffin (Australia)

Theme 17 – The Early Earth: Hadean and Archean Development of a Habitable Planet – Vickie Bennett vickie.bennett@anu.edu.au (Australia) and Tony Kemp (Australia)

Theme 18 – The Proterozoic Earth – Peter Betts peter.betts@sci.monash.edu.au (Australia) and Martin Hand (Australia)

Theme 19 – Geochronology and Isotope Geology – Paulo Vasconcelos paulo@earth.uq.edu.au (Australia), Donald Depaolo (USA) and Igor Villa (Switzerland)

Theme 20 – Planetary Sciences – Graziella Caprarelli graziella.caprarelli@uts.edu.au (Australia), Monica Pondrelli (Italy), Charles Lineweaver (Australia), James Head (USA) and Phil Nicholson (USA)

Theme 21 – Magmatism – Settings, Compositions and Processes – Janet Hergt jhergt@unimelb.edu.au (Australia) and Jon Blundy (UK)

Theme 22 – Metamorphic Rocks and Processes – Jörg Hermann joerg.hermann@anu.edu.au (Australia), Geoffrey Clarke (Australia) and Simon Harley (UK)

Theme 23 – Evolution of the Biosphere – John Laurie john.laurie@ga.gov.au (Australia) and Andrew Knoll (USA)

Theme 24 – Reefs and Carbonates – Gregory E Webb g.webb@uq.edu.au (Australia) and Noel P James (Canada)

Theme 25 – Marine Geoscience and Oceanography – Neville Exon (Australia) neville.exon@anu.edu.au

Theme 26 – Antarctic and Arctic Geoscience – Phil O'Brien phil.obrien.ant@gmail.com (Australia) and Tim Naish (New Zealand)

Theme 27 – Biogeoscience – Matthew Stott m.stott@gns.cri.nz (New Zealand) and Jill Banfield (USA)

Theme 28 – Groundwater/Hydrogeology – Ken Lawrie ken.lawrie@ga.gov.au (Australia) and Chris Daughney (New Zealand)

Theme 29 – Surficial Processes and Landscape Evolution – Allan Chivas toschi@uow.edu.au (Australia) and Brad Pillans (Australia)

Theme 30 – Geohazards – Phil Cummins phil.cummins@anu.edu.au (Australia), Terry Webb (New Zealand) and Kelvin Berryman (New Zealand)

Theme 31 – Engineering Geology and Geomechanics – Mark Eggers mark.eggers@psmconsult.com.au (Australia) and Francisco De Jorge (Brazil)

Theme 32 – Geoscience Information from Proximal and Remote Sensing Technologies – Tom Cudahy thomas.cudahy@csiro.au (Australia), Adam Lewis (Australia) and Carlos De Souza Filho (Brazil) [UNESCO – IUGS Geological Applications of Remote Sensing (GARS) program]

Theme 33 – History of the Geosciences – Barry Cooper barry.cooper@unisa.edu.au (Australia) and S F de M Figueirôa (Brazil) [37th Conference of the International Commission on the History of Geological Sciences – INHIGEO]

Theme 34 – Major Geoscience Initiatives, Geosurveys and Maps – Ian Lambert ian.lambert@ga.gov.au (Australia) and Ian Withnall (Australia)

Theme 35 – Geostandards – Colin Simpson simpsons@grapevine.com.au (Australia) and William Cavazza (Italy)

Theme 36 – Regional, Thematic and Specialist Symposia – Ian Lambert ian.lambert@ga.gov.au (Australia)

Theme 37 – Alternative Concepts – Expanding Earth (Sam Carey Memorial) Giancarlo giancarlo.scalera@ingv.it (Italy), James Maxlow (Australia), Cliff Ollier (Australia) and Stefan Cwojdzinski (Poland) – Pursuit of a new global geodynamic paradigm – Dong Choi raax@ozemail.com.au (Australia), Ismail Bhat (India) and Karsten Storetvedt (Norway)

Other major forums

Major forums held in addition to the themes, and their convenors, are summarised here.

International GeoSurveys Forum

Applying geoscience to address the world's major challenges – Chris Pigram (Australia) and Alex Malahoff (New Zealand)

Global Geoscience Initiative (GGI)

Developing a Geoscience Roadmap as part of the Belmont Forum – IUGS and ICSU, with organisers Edmund Nickless, John Ludden, Pat Leahy and Jack Hess

Earth Science Matters

Successor to the International Year of Planet Earth (IYPE)– Ed de Mulder and Wolfgang Eder

Hosting societies

The 34th IGC was hosted and supported by the member societies of the Australian Geoscience Council:

Association of Applied Geochemists (AAG)
 Australasian Institute of Mining and Metallurgy (The AusIMM)
 Australian Geoscience Information Association (AGIA)
 Australian Institute of Geoscientists (AIG)
 Australian Society of Exploration Geophysicists (ASEG)
 Geological Society of Australia (GSA)
 International Association of Hydrogeologists (IAH)
 Petroleum Exploration Society of Australia (PESA)

Institutional supporters

Geoscience Australia was the major institutional supporter of the IGC and their support was a credit to the foresight of Neil Williams and the ongoing leadership of Chris Pigram, Chief Executive Officer, Geoscience Australia. Congratulations should also be extended to Geoscience Australia for their outstanding publication *Shaping a Nation*. Like all effective collaborations, this unique publication came together with the contributions of many authors and was perfectly timed to showcase the geology of Australia to an international audience! (Look for the order form in this issue of *TAG*). Other institutional supporters included:

Department of Manufacture, Innovation, Trade, Resources and Energy (DMITRE)
 Geological Survey of Queensland – Department of Employment, Economic Development and Innovation
 Geological Survey of Western Australia – Department of Mines & Petroleum
 GeoScience Victoria – Department of Primary Industries
 GNS Science, New Zealand
 Mineral Resources Tasmania – Department of Infrastructure, Energy and Resources
 New South Wales Geological Survey – Department of Primary Industries
 Northern Territory Geological Survey – Department of Regional Development, Primary Industry, Fisheries and Resources



Professor Iain Stewart.



Left to right: Ian Lambert; Lord Ron Oxburgh (UK), Secretary General; and Lynton Jacques, Scientific Program Chair.



Vale, Principal Sponsor, presented a sand sculpture that changed daily.

Major sponsors

Without sponsors organisations would find it difficult to hold conferences of the calibre of the 34th IGC. Organisations sponsor conferences for different reasons. These include that the conference might have synergies with their brand, enhance their image or target a niche they want to get closer to – especially relevant when sponsors are actively seeking to recruit.

The sponsors of the 34th IGC contributed to the conference success – and in case you didn't know who they were:

Australian Academy of Science
Australian Geoscience Council
BHP Billiton
BHP Billiton–Mitsubishi Alliance
CO2CRC – CRC for Greenhouse Gas Technologies
Events Queensland
Geoscience Australia
IHS
Linc Energy
Moultrie Group
Newcrest Mining
Origin
Petrobras
QGC – Queensland Gas Company
Queensland University of Technology
Rio Tinto
Rowland
Surtron
UNESCO
University of Queensland
Vale
Xstrata

The 1st IGC

- in recent times to be held over a shortened period of 5 days
- where all circulars were distributed only in electronic form
- to host a world Young Earth Scientist (YES) conference
- to formally take into account Ramadan and make appropriate arrangements for Muslim delegates
- to have a majority representation from New World countries
- to have a major focus on the private sector (the biggest employer of geologists around the world)
- to hold a Ministerial Forum.

Statistical snapshot

6012 delegates
112 countries represented
3232 oral presentations
5 plenary sessions
24 professional development workshops
29 multiple-day field trips
283 exhibitors in the GeoExpo hall
244 delegates for the GeoHost program
70+ business meetings
20+ media statements

34th IGC — NZ-4 field trip summary Christchurch, New Zealand

After a week at the IGC in the pleasant climate of Brisbane, participants of the NZ-4 post-conference field trip (11–15 August 2012) *Christchurch: the recent Canterbury earthquakes set in the expansion of plate deformation east of the Alpine Fault* re-grouped in wintry Christchurch the following day. Following the short flight from Brisbane to Wellington, it wasn't long into our next flight across the northern tip of the South Island that we could see spectacular views of the snow-covered Alps below. It was an exciting introduction, not only to the winter wonderland of the South Island, but also to the impending field trip! Over five days, the field trip covered the effects (both geological and built) of the recent Darfield (magnitude 7.1, 4 September 2010) and Christchurch (magnitude 6.3, 21 February 2011) earthquakes. We were shown young scarps alongside the Alpine Fault, some other major tectonic structures, the Castle Hill Basin (a montane tectonic basin), glacial features on the Waimakariri River and last, the Waipara Basin and young structures emerging beneath the Canterbury Plains. As the field trip was filled with so much information, I will focus here on the highlights of our tour of Christchurch.

The field trip was primarily led by Jocelyn Campbell and Brendan Duffy from the University of Canterbury. As we set out by coach through Christchurch on a wet start to day 1, David Bell, an engineering geologist, joined us. Through rain-washed bus windows we clearly saw the surface damage throughout town – in the houses without chimneys, boarded-up windows and collapsed stone fences. Then there were the bumpy roads and wonky culverts, uneven bridge crossings and building rubble. On the way out to the Port Hills, colourful, stacked shipping containers lined the roadside as buffers to future rockfalls. The first stop was the site of a major rockfall behind Redcliff School, which we noticed from the road was fenced off and empty of

school children. Here, along the base of the cliff sat a line of abandoned houses where roofs were punched with holes and encircled by newly fallen rubble. Atop the cliff, another cluster of abandoned houses stood at strange angles, rooflines askew. Evidently, the location of houses below these cliffs (comprised of a series of ash layers, basalt and ignimbrites) was not considered to be a problem at the time of construction. This scene of rock-fall-related damage continued throughout the suburb of Sumner, which was badly affected by the 21 February 2011 earthquake.

Another major cause of building damage was liquefaction and lateral spreading in riverbank gravels along the Heathcote Estuary and Avon River. In Avonside, street after street of houses had been abandoned as ground ruptures affected the buildings' foundations and/or structural integrity. The uneven road was the first indication of subsidence, although it was not until we took a closer look at street level that we saw why these houses were empty. In one instance, a surface rupture ran across the front yard of one house, affecting the foundations, and then continued through the side fence to damage the neighbouring house. It was tragic to see these charming houses with their leadlight windows (built from the 1880s to 1920s) in such a depressing state. It seemed the old weatherboard houses survived the lateral spreading better than the brick houses. Bricks made of Sumner rock have a flat top and base and therefore provided no flexibility during the earthquake.

Next we were shown a study site adjacent to the Avon River where Masters student Sarah Baston is looking into the liquefaction history. Her trench revealed multiple generations of liquefaction and paleoliquefaction, indicating that there was pre-Darfield seismicity in the area. In total, 150 houses were lost to cliff collapse and rockfalls, while roughly 6000 houses were lost from liquefaction and lateral spreading.

We then wound our way through the back streets towards the CBD. At one stage a road closure and road repairs made us turn around. Finally in the CBD, we noted many of the historic building frontages were boarded up and fenced off at the awning for pedestrian safety. Orange bollards and signs declared 'Road Closed' or 'No Public Access'. There were excavators clearing away rubble in empty building sites, and then there were whole blocks of damaged buildings, some with scaffolding, others covered with tarpaulins. One building had been recently demolished, leaving a pile of jagged rubble and dust. We were able to take a short walk down to the Christchurch Cathedral site cordoned off by high fences. Scaffolding was present where the steeple once stood and another wall had started to crumble away. It was obviously once a magnificent building and as it was located at the heart of the city, it represented much more than just a cathedral. Places where building damage is most severe around Christchurch have been mapped as 'Red Zones'. These zones closely correlate with gravel point bars along the Avon River, which are sources of liquefaction throughout Christchurch.



Group photo in front of Lake Poerua, Inchbonnie, near to surface expression of the Alpine Fault. Photo courtesy Emma Mathews.



The Greendale Fault where it emerges at Highfield Road. Displacement of the fence line and hedge show the amount of extension and uplift that occurred along this part of the fault. Image courtesy Emma Mathews.

After a welcome lunch, we continued to travel west across the green pastures of the Canterbury Plains towards Darfield. Grey skies persisted. At the eastern end of the Greendale Fault (GF), it emerged as a kink in the railway line, and had been smoothed out since the earthquake. The countryside was slightly undulating, but we could see the evidence of uplift and extension in a small rise of the tracks and abrupt change in the height of a nearby hedge. Now we had our eye in for these subtle landscape changes as we moved to the next stop on Highfield Road. This was the site of major surface rupture of the GF as it crossed the road. Although the road had since been resurfaced, the large hedges and fences lining the road still show the GF trace. Both had marked offsets and were no longer in a straight line. The site was also on a rise, higher than the surrounding landscape, which we were told was flat before the Darfield earthquake! Interestingly, the magnitude 7.1 quake occurred on the Charing Cross Fault to the north of the GF, which triggered GF movement.

Following our visit to the GF, we travelled into the alpine areas of Porters Pass and Arthurs Pass towards Inchnonnie. There was so much more of the tectonic regime and structures to see in the remainder of the trip. But the ongoing effects of the Darfield and Christchurch earthquakes on the daily lives of the people of the city are what will linger in my memory. The media coverage has stopped in Australia, but the damage around Christchurch is significant. This part of the trip was memorable not only for the effects of the earthquake, but also because I don't think we left the coach without our raincoats for the entire day!

EMMA MATHEWS
ACT Division

34th IGC — Symposium 1.1 on Geoheritage, Geoparks and Geotourism

Conveners — Bernie Joyce & José Brilha

A strong ProGEO presence from Europe and many presentations from other countries across the globe, with sessions running over three full days, made this symposium the biggest international gathering to meet in Australia to discuss the three G's — *Geoheritage, Geoparks and Geotourism*.

A total of 44 oral presentations included keynotes by Kevin Page, Patrick McKeever, Ross Dowling and Jonathan Tourtellot. Fifteen posters were displayed for discussion. Total attendance, with numbers up to 80 at a time, can only be described as excellent. Also making major contributions to the smooth running of the symposium were Margaret Brocx, Lars Erikstad, Changxing Long and Angus M Robinson.

The final day concluded with a session entitled 'Final discussion and plans for the future' led by José Brilha. The conclusions reached, and other details of the meeting, together with the final version of the Geoheritage Symposium program, will remain available on line at <http://web.earthsci.unimelb.edu.au/Joyce/heritage/IGCGeoheritageSymposia2012.html>. Additional news will be added to the website from time-to-time.

A full symposium report is being prepared by Ian Lewis and will be published in the journal *Geoheritage* soon.

Manuscripts are being solicited for a special volume of *Geoheritage* and should be uploaded now to <http://www.springer.com/earth+sciences+and+geography/geology/journal/12371>.

BERNIE JOYCE



One of several post-conference excursions in the Brisbane area included the Tweed volcano, with Warwick Willmott, doyen of Queensland geological heritage studies, as one of the leaders. Image courtesy Sung Rock Lee.

Sponsored student reports

Many organisations, including the GSA Specialist Groups and Divisions, sponsored students to attend the 34th IGC. Thank you to all the groups that sponsored students. Here's what some students had to say about their experiences.

Johannes Hammerli

Thanks to the support by the Specialist Group in Geochemistry, Mineralogy and Petrology (GSA) (SGGMP), I was able to attend the IGC in Brisbane in early August. As my PhD project focuses on trace element behaviour and Nd, Sr and O isotope systematics on prograde metamorphism, I was particularly interested in the sessions 'Understanding migmatites' and 'Accessory phases and trace elements in metamorphic processes'.

The keynote presentation by Ed Sawyer 'Composition and microstructure in understanding migmatites' was definitely one of the many highlights of the conference. All talks in the above sessions were very well attended and I was given the opportunity to present my research 'In-situ Nd and Sr isotope measurements on accessory minerals from a prograde LP/HT sequence – Insights into isotope equilibration during metamorphism' in the latter session.

There was plenty of time for discussions during the breaks (on the almost non-ending route to find some coffee) – and these have already led to fruitful collaborations. Within the scientific program there was time to socialise with a few refreshments, for instance at the BBQ organised by the Economic Geology Research Unit (EGRU) of James Cook University. The whole conference was very well organised ... but if only there was beer at the poster sessions ...

JOHANNES HAMMERLI

School of Earth and Environmental Sciences

James Cook University, Townsville

Article based on SGGMP Newsletter September 2012: article used with permission.

Gisela Cobenas

I am pleased to have attended the IGC and I am very thankful to the SGGMP for their financial support. This conference has benefited my research immensely. I had the opportunity to present at the 'SW Pacific Magmatism' special session. My talk was entitled 'Metal evolution during differentiation of calc-alkaline magmas (Hunter Ridge, SW Pacific)'. The feedback I was given was very positive and it was great to discuss my results and findings with other key researchers in my field.

I also attended the sessions on 'Footprints of mineralised systems: new concepts and data for exploration', 'Orogen to district-scale structural and tectonic controls on porphyry and epithermal deposits', 'Giant and super giant orebodies', 'Magmatism in extensional environments (continental rifts and MORB)' and 'Origin and evolution of marsupials'. I found all these sessions very interesting, well structured and informative.

Finally, as I intend to become a researcher after completing my PhD, attending the conference was an important opportunity to meet potential sponsors to help me develop my career – and undoubtedly has helped me to expand my network.

GISELA COBENAS

PhD student ARC Centre of Excellence in Ore Deposits (CODES)
University of Tasmania, Hobart

Article based on SGGMP Newsletter September 2012: article used with permission.

Ed Saunders

I recently received sponsorship from the SGGMP group of GSA to attend the IGC, where I presented some results from my PhD research. My project focuses on the gold geochemistry in the upper mantle, and I have been using *in situ* analytical techniques to measure the sulfide chemistry from mantle xenoliths to understand how gold behaves during mantle processes. At the IGC, I presented results from xenoliths from Svalbard, North Atlantic, which show a relationship between silicate and sulfide metasomatism, and how these metasomatic events alter the Au concentration within the mantle.

I attended a wide array of sessions at IGC, all of which were very interesting. Several talks stood out as highlights. The session on the global sulfur cycle and its impact on metallogenesis was particularly interesting. The keynote by Cin-Ty Lee in this session discussing the use of Cu systematics in understanding crust–mantle differentiation was fascinating. The follow-up invited talk by Iain Pitcairn looking into constraints on the mobility of gold during metamorphism was also extremely relevant. This session in particular, and the conference in general, definitely gave me a new perspective on my research, and new avenues that I can use my data to explore.

ED SAUNDERS

PhD student, Macquarie University

Article based on SGGMP Newsletter September 2012: article used with permission.

Kieran Meaney

As an Honours student in geology, fresh out of my undergraduate degree and halfway through my research project, being offered the opportunity to attend such a large event as the IGC was quite special. I ended up spending a week in Brisbane with some of my fellow students and academic mentors, and was able to learn so many new ideas and concepts in geology, many of which were very relevant to my own project. It was fantastic to see the people who had taught me over the years present some of their work on an international stage. Even simple things, such as just being able to put some faces to the names I had seen so often attached to published works, made the whole experience very interesting.

In addition to all the lectures and presentations, I attended a professional development workshop on how to communicate geoscience to the general public. So at the very least I can now better explain to my family and friends what it is that I actually do!



Johannes Hammerli. Image courtesy Johannes Hammerli.



Gisela Cobenas at Cape Hauy in the Tasman peninsula, where the dolerite column formations are spectacular. Image courtesy Francisco Testa.



Ed Saunders on an undergraduate fieldtrip to the Ormiston Gorge in the Northern Territory, which he attended as a tutor. Image courtesy Charmaine Thomas.



Kieran Meaney with his poster at the 34th IGC. Image courtesy Kieran Meaney.

The most exciting and rewarding moment of all, however, was the chance to display a poster of my own work and the results from my project so far. It was a great feeling to have other researchers see my work, ask questions with genuine interest and discuss what affect my work might have on theirs. In moments like these there is a great feeling of accomplishment, and not the kind that I was expecting to feel throughout my Honours year.

I would like to thank everyone who supported me, and especially my supervisor, Alan Collins, for putting me up to the challenge of presenting. I would also like to thank the South Australian Division of the GSA for their generous financial sponsorship, without which I may not have been able to attend.

KIERAN MEANEY

Honours student, University of Adelaide

Nick Lyons

The ICG was a fantastic opportunity for a young geologist like me to meet and interact with the global geological community for the first time. I feel very fortunate to have attended.

There were many, many highlights of the conference, but three specifically come to mind.

The first was the chance to present a poster about some of the work I had completed from my 2012 Honours thesis *Evidence of magmatic hydrothermal mineralisation at Kanmantoo Au-Cu deposit, South Australia*. Some of the insightful feedback I received about my work I will carry through the remainder of my geological career. The chance to 'talk rocks' with geologists from around the world will always be a great memory.

The second highlight was the chance to listen to some of the very insightful, ground-breaking research that is currently being undertaken on some of the largest ore deposits around the world. Presentations on the porphyry deposits of South America and epithermal deposits of the Indonesian archipelago, the models for formation and challenges when exploring for them were intriguing.

The third highlight was seeing the quality of representation from Australia, and the immense interest in Australian geology from the international community. The research and development of iron-oxide-copper-gold (IOCG) deposits in Australia and the contribution that Australia is making towards these unique deposits was encouraging to see. Contributions from Australian researchers to the supercontinent cycle and global tectonics were also of great interest, as was the pride shown towards the Australian geological community.

I would like to thank the GSA SA Division, and the scholarship that I received, without which I would not have been able to attend and be involved in this once-in-a-lifetime experience.

Rock on GSA SA!!

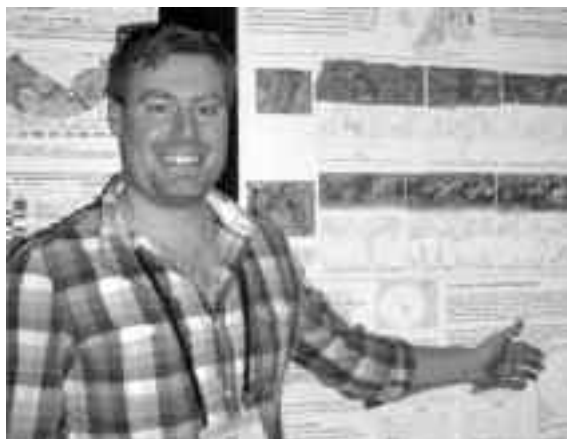
NICK LYONS

Honours student, University of Adelaide

Yuan Mei

I would like to acknowledge the SGGMP and the South Australia Division of the GSA for sponsoring my registration to attend IGC this year.

I gave an oral presentation in the session 'Global sulfur cycle and impact on metallogenesis' with the title 'Speciation and thermodynamic properties of d^{10} transition metals: insights from *ab-initio* molecular dynamics simulations'. In this talk, I shared the idea of applying computational chemistry methods to get a molecular-level insight into the physical and chemical factors that affect ore transport and deposition over a wide range of conditions. In particular, I presented my recent studies that show how molecular dynamics simulation helps us to understand the coordination chemistry and structural properties of metal complexation, how to derive the thermodynamic properties and build metal transport-deposition models, and to predict the metal speciation for experimentally unknown systems.



Nick Lyons with his poster at the 34th IGC.
Image courtesy Nick Lyons.



Yuan Mei in the lab. Image courtesy Yuan Mei.



Fiona Mothersole with an Australian snake at the 34th IGC. Image courtesy Fiona Mothersole.

Attending the IGC was significant for me since it offered me the opportunity to present my new results to a public of geoscientists. It was also a great opportunity for me as a physical chemist to learn more about geology. The brainstorming during the conference provided me with many new ideas not only for my current research project, but also the way to understand the geological world and to link theoretical studies with observations.

The session 'Global sulfur cycle and impact on metallogenesis' was one of the most exciting sessions for me. It was well organised, and had a good combination of invited and keynote speakers and young scientists like me. I learnt a lot from other talks in this session, and received many useful comments for my current study. The increased visibility of my research benefited not only me, but also helped our research group to build new collaborations nationally and internationally.

YUAN MEI

PhD student, University of Adelaide

Fiona Mothersole

First, I would like to thank the GSA and the SGGMP for sponsoring my trip to the IGC. The funding was greatly appreciated and allows me to use valuable project funding for future research.

The IGC, which I like to call the 'Geology Olympics', started in an unexpected way. Registration at the Brisbane Convention and Exhibition Centre coincided with Sexpo (at the same venue) – it was quite amusing to play 'spot-the-geologist' among the crowds while waiting for the evening reception. Walking into the main hall for reception was quite daunting, seeing the vastness of the event, but the friendly environment made it more manageable. With over 5000 delegates representing over 100 countries it was truly impressive.

Despite the unusual start on registration day, the first day of the IGC was business as usual. My poster 'Comparison of serpentinisation and geological setting' was presented at the

evening poster session on the first day. The poster is a comparison of protolith, mineralogy and petrology via serpentinite vein generations to assess if ophiolitic serpentinisation can be used as a proxy for less-accessible abyssal serpentinisation. My poster was very well received; I had parties directly interested in work on serpentinisation, and interest also from those who knew very little about the topic. It was an amazing opportunity to present at such a prestigious event, especially as a PhD student. I really enjoyed presenting my poster and it was great to have one-on-one interaction with other geologists who you might only meet through attending the IGC. There was great enthusiasm regarding my project and I had some interesting suggestions on future work.

As my presentation was on the first day of the IGC, I was able to relax and really enjoy the rest of the conference. Presentations and poster sessions on such a huge variety of topics meant that there was always something of interest. The main hall held exhibitors from industry, publishers and geological societies representing global geoscience. It was a great informal environment to interact with and learn from the variety of exhibitors. There were events like 'guess the rock' and lots of freebies, which is always enjoyable for a student.

It was certainly an Australian-style IGC, with the blue skies, relaxed feeling and photo opportunities with Australian wildlife. Just like the 2012 Olympics running at the same time in London showcasing amazing sporting events, I think the 'Geology Olympics' was a great event to showcase geology and to bring together delegates from around the world.

FIONA MOTHERSOLE

PhD student, Department of Applied Geology
Curtin University, Perth

Article based on WAG, No. 497, October/November 2012:
article used with permission.

Let the games begin ...

By now the Games of the XXX Olympiad will be a distant memory and we will have forgotten all the hype, expectations and soul-searching that went on. No doubt we are now in the 'let the post-mortems begin' phase, which may go on for four years: more soul-searching.

Two things strike me about the Olympics Games. First, with gold medals in everyone's thoughts it was suggested that pouring more money into sport would ensure more gold in the future. This is somewhat akin to the idea of pouring more troops into a battle in order to defeat the enemy. There was also the suggestion that we need more compulsory sport in our schools to find the gold-medal winners of the future. But surely the future of Australia depends not on gold medals but on a highly skilled workforce. We need more money spent on mathematics and science in our high schools (let alone more emphasis on the three R's in primary schools).

The second thing that struck me was the amount of media attention given to the Games. It was hard to get away from them even if you didn't sit up all night and watch Channel 9. My ration of media is restricted to some TV news and a stream of RSS feeds on my computer. Even on this limited diet I could always keep up-to-date with who was winning (or losing).

Yet, at the same time, in our own country we were celebrating the geological equivalent of the Olympic Games: the 34th International Geological Congress (IGC) in Brisbane. How much media attention did it attract? Nothing showed up on my RSS feeds, and very little on the TV news. The only item I read was from a petroleum industry website that reported a Geoscience Australia study of the petroleum potential of the northern offshore Perth Basin. Obviously there is very little interest in the science that underpins the Australian economy. This goes back to my first point: the lack of funding for science in the school

system. With little or no understanding of the role of science in society, the media can safely ignore the local geological Olympiad and concentrate on the Olympiad on the other side of the world.

One media release put out by the 34th IGC was entitled 'Rock stars head to Brisbane' and mentioned 'Popular BBC presenter Iain Stewart and former Shell Chairman Lord Ron Oxburgh'. This prompts me to ask, "Where are our own 'rock stars'?" I am sure we can all compile such a list, which would be very subjective. The point I make here is that while the GSA recognises its 'rock stars' through the award of medals at the Australian Earth Science Conventions, there is very little wider recognition of our outstanding Earth Scientists. I usually look in vain in the twice-yearly Australian Honours Lists for names of geologists. There are plenty of names from the medical profession, the arts and politics, but very few Earth Scientists. Obviously other professions have much better ways of nominating their members for awards. Surely this is something that our own Awards Committee should be involved in.

Let me finish my comparison of the two 'Olympiads' on a more cheerful note. The *EARTH* magazine website has an interesting article 'Welcome to the GEOlympics' setting out a geological decathlon through Great Britain (<http://www.earthmagazine.org/article/bare-earth-elements-welcome-geolympics>). These must-see geological sites in Great Britain range from Fingal's Cave to the Dorset Jurassic coast. While not everyone will agree with the author's choice, they do show the enormous range of fascinating geological features that exist in the UK. It would be interesting to compile a similar geological decathlon for Australia. I suspect a start could be made at the 34th IGC website looking at the wide range of excursions offered (and cancelled!). Have a look at <http://www.34igc.org/field-trips.php> and see what you think.

Free geology books and maps available

Contact Peter Bone at frankieshouse@gmail.com

1. ***Twenty Five Years of Geology in New England***
AH Voisey, The University of New England, Armidale, NSW
2. ***Alcheringa — An Australian Journal of Palaeontology*** Vol. 1, No. 1, 1975 Graphic Services Pty Ltd, Adelaide SA
3. ***Chronological Narrative of the 1969–71 Mauna Ulu Eruption of Kilauea Volcano, Hawaii***, Geological Survey Professional Paper 1056 US Government Printing Office, Washington, 1979

4. ***Historic Ground Failures in Northern California Associated with Earthquakes***
Geological Survey Professional Paper 993 US Government Printing Office, Washington, 1978
5. ***Landforms Illustrated*** CR Twidale & MR Foale Thomas Nelson (Australia) Ltd, 1969

Maps prepared by United States Department of the Interior Geological Survey

Books for review

Please contact the Geological Society of Australia Business Office (info@gsa.org.au) if you would like to review any of the following publications.

Re-advertised

Essays in Honour of Frederico Waldemar Lange, Pioneer of Brazilian Micropaleontology Continent

EP Bosetti, Y Grahn, JHG Melo
www.editorainterciencia.com.br

Geomechanics Applied to the Petroleum Industry

Jean-Francois Nauroy
www.editionstechnip.com

Uluru and Kata-Tjuta: a geological guide

IP Sweet, AJ Stewart & IH Crick
www.ga.gov.au/products-services/publications.html

Minerals, Metals and Sustainability: meeting future material needs

WJ Rankin
www.publish.csiro.au

Clean Energy, Climate and Carbon

Peter J Cook
www.publish.csiro.au

From the Geological Society of London

The following books are published by the Geological Society of London, www.geolsoc.org.uk/bookshop but are available from the GSA for review. Contact info@gsa.org.au.

SP293 Metasomatism in Oceanic and Continental Lithospheric Mantle

M Coltorti and M Gregoire

SP313 Underground Gas Storage

DJ Evans and RA Chadwick

SP337 Petrological Evolution of the European Lithospheric Mantle

M Coltorti, H Downes, M Gregorie & SY O'Reilly

SP341 Evolution of the Levant Margin and Western Arabia Platform since the Mesozoic

C Homberg & M Bachmann

SP343 Dinosaurs and Other Extinct Saurians: a historical perspective

RTJ Moody, E Buffetaut, D Naish & DM Martill

SP358 Comparing the Geological and Fossil Records

AJ McGowan & AB Smith

SP361 Natural Hazards in the Asia-Pacific Region: recent advances and emerging concepts

JP Terry & J Goff

SP362 Military Aspects of Hydrogeology

EPF Rose & JD Mather

Quizine ANSWERS (From page 17.)

1 c

3 f

5 b

7 h

9 e

2 j

4 i

6 d

8 g

10 a

Calendar 2013

18–22 March

Geology of Gold course

School of Earth Sciences, University of Melbourne
kerryh@unimelb.edu.au

2–5 June

2013 EGRU conference, FUTORES

(Future and understanding of Tectonics, Resources, Environment and Sustainability)

Townsville, Queensland
<http://www.jcu.edu.au/futores/>

11–14 August

ASEG–PESA2013

23rd International Geophysical Conference and Exhibition

Melbourne, Australia
<http://www.aseg-pesa2013.com.au>

18–21 November

26th International Applied Geochemistry Symposium, incorporating the New Zealand Geothermal Workshop

Rotorua, New Zealand
<http://www.gns.cri.nz/iags>

Book Review

Salt Tectonics, Sediments and Prospectivity

GI Alsop, SG Archer, AJ Hartley, NT Grant & R Hodgkinson (Eds)

Geological Society of London, Special Publication 363, London, 2012, 624 pages
ISBN 978-1862393417

The work covers many of the world's significant diapiric provinces: the Cretaceous La Popa Basin in Mexico, the Flinders Ranges in South Australia, the Santos Basin offshore Brazil, the Kwanza Basin offshore Gabon, the Gulf of Mexico, the Laurentian Basin Grand Banks in eastern Canada and the offshore Parentis Basin in the Bay of Biscay. The book also covers the Polish and Central European salt basins: the Dnieper–Donetz Basin Ukraine, the Levant Basin off Tel Aviv in the Eastern Mediterranean, offshore Holland, the South Oman Salt Basin, the Zagros Mountains and Great Kavir of Iran, northern Tunisia and Haute Provence in France. Finally there is a discussion of the Poza de la Sal Diapir in the Basque Pyrenees and if we are not yet satisfied, we are treated to salt evacuation structures/welds near Watchet on the south coast of the Bristol Channel, UK.

It is the first Geological Society Special Publication dedicated to salt tectonics and is the result of a London conference in January 2010 of the Petroleum Group of the Geological Society and the Society for Sedimentary Geology. The main themes of the papers are halokinetic sequence stratigraphy, salt in passive-margin settings, the central European salt basins, deformation within and adjacent to salt, salt in contractional settings and salt glaciers. There are five papers in the first category by nine different authors, ten papers with 28 authors in the second and four papers with ten authors on the European salt basins. Deformation related to salt has six papers with the combined expertise of 22 authors. Contractional settings and salt glaciers has four papers with 14 contributing authors. In total, 80 or so authors are represented in the volume.

This volume is presented with clear figures of seismic interpretations, modelling studies, field maps and photographs with colour. There is some unfamiliar nomenclature such

as inverted depocentres, mechanisms of flip-flop salt tectonics, expulsion basins and salt sheet breakouts. There is also extensional salt withdrawal, welding and contractional salt inflation and extrusion, along with progradational extrusion and salt nappes with minibasin formation, along with many more.

An early stage of salt tectonics appears to be extensional slip and passive salt diapirism due to downbuilding in a salt basin. This might develop in different ways, giving rise to a whole classification of diapiric bodies, minibasin forms and welds. Rejuvenation by squeezing of the dominant salt diapirs, pillows and allochthonous canopies can then lead to more complex structures and nappes. Complexity in the sequence stratigraphy of salt basins has its own nomenclature dependent on the interaction of salt movement, sedimentation and erosion with the ultimate possibility of canyon formation and submarine 'salt glaciers'. It is worth commenting that many such examples are to be seen in the published geological mapping of the Flinders Ranges.

The authors clearly form an integrated group of global researchers who have access to worldwide study areas and selected seismic and other modern data, which are presented beautifully with liberal colour and adequate explanatory figures. The compilation is a delight to review.

It is pleasing to see Australia's own Witchelina Diapir presented as a hyper-spectral image for the chosen example of a naturally outcropping cross-section of a diapir. It is described as having a megaflap and primary minibasin and breakout of 'salt' into a welded canopy. I must point out, however, that the labelling of 'autochthonous salt' in the core of the structure is unsubstantiated. This is a point of considerable significance as we are yet to identify the evaporites in the Adelaide Geosyncline.

The most detailed paper on depositional and halokinetic sequence stratigraphy is based on the Wonoka Formation (Wilpena Group) of the Ediacaran in the Central Flinders Ranges. In this paper, Kernen *et al* discuss the

Patawarta Diapir as an allochthonous salt sheet and provide paleogeographic settings and stratal relationships as determined from surface mapping. It is a good example of the information available in accessible areas in South Australia's Neoproterozoic and Cambrian diapir province, which must rank among the world's premier study areas.

I really recommend this book to those interested in development and comparison of salt structures during basin evolution. It is a valuable compilation of modern data from most of the world's premium evaporite basins and should be a reference for all petroleum students and structural geologists. This copy will be passed on to those working in this field at Adelaide University.

It is unfortunate that history has lost track of the similar compiled work *Diapirism and Diapirs (Memoir 8 AAPG 1968, J Braunstein and GD O'Brien, Eds)*, which covered similar world provinces and included a joint contribution by this reviewer on diapiric structures and sedimentation in the Flinders Ranges. This publication was the result of a conference in New Orleans in 1965 and it provides an overview of diapirism at that time. In particular it provides an excellent index and indexed bibliography, which are useful for reference. Advances in understanding since this date are considerable although the principles in many of the examples quoted in current literature were clear from early phases of geological mapping, mining, oil and gas exploration and laboratory work. Quality seismic is the real breakthrough for subsurface examples and petroleum search and this is well presented in the present volume.

R DALGARNO
PO Box 8051
Mount Gambier East, SA

Omission...

In the photograph on p 39 of TAG 164, Brian Skinner and Peter Howard were featured with Professor Catherine Skinner and Michelle Vale.

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September 2013	29 July	9 August	23 August
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