

Education matters



Michael Asten
Associate Editor for Education
michael.asten@monash.edu

'Exploring for the Future' brings opportunities to universities

University geoscience programs can expect to be indirect beneficiaries of the 'Exploring for the Future' special allocation to Geoscience Australia, announced in the Commonwealth Budget on 3 May. Provision of \$100 million over four years (in addition to the GA standard budget) was announced by Minister for Resources Energy and Northern Australia Josh Frydenburg, with funds to be directed to minerals, energy and groundwater potential in northern Australia and South Australia. The stated intention is to deliver a program of data acquisition and analysis that will allow Australia to identify new greenfield exploration sites for future development, and it is an outcome of the UNCOVER seminars, workshops and conversations that have been held nationally since the Australian Academy of Sciences initiated discussions on this challenge four years ago.

Geoscience Australia has a strong tradition of collaborating with universities in the past across a wide range of research topics, and in being an employer of choice for many of our top graduate students. We can look forward to many more such opportunities as details of this program are released.

Chris Pigram, CEO of GA, welcomed the budget outcome saying 'The program will be wide ranging and hence offers the opportunity to build on our extensive

record of collaboration. We welcome collaboration to assist us to tackle the many challenges that will arise as we attempt to understand the geological evolution of northern Australia, and the resource endowment that has accrued.'



Chris Pigram
CEO Geoscience Australia

Research Foundation announces \$103K in grants for graduate student projects



Phil Harman
Research Foundation Chair

On behalf of the ASEG Research Foundation I would like to acknowledge and thank the ASEG Federal Executive for their recent donation on behalf of the ASEG, of \$100 000 to help support the research grants for 2016.

This year we received 17 excellent applications, 8 for petroleum, 7 for minerals and 2 for engineering. Of

these 8 were chosen for support, 3 in petroleum, 4 in minerals and 1 in engineering, some at a slightly reduced level to what was requested.

At the Foundation our policy is that we only commit support with funds that we already hold so that we can be sure that we are able to deliver on what we promise. The trend now is that more proposals are coming at the PhD level so we need to look beyond the current year in retained funds. This makes the support of the ASEG even more critical to the future of the Foundation, which is now well past a total of \$1 million invested since its formation in the 90s.

Thanks also to the Members, both private and corporate that have donated to the Foundation this year. Their individual contributions not only give us great moral support but also add considerably to what the Foundation is able to achieve financially ... just a few thousand dollars is an extra Honours scholarship.

Just to remind everyone, the Research Foundation was established to help students with the additional cost of essential field and laboratory work needed to carry out their research. The Foundation qualifies as a registered charity and hence all donations are tax deductible.

Once again thanks to Doug Roberts our Secretary for coordinating the granting of this year's awards and to Peter Priest our Treasurer. Also thanks to Koya Suto for liaising with the Federal Executive on our behalf.

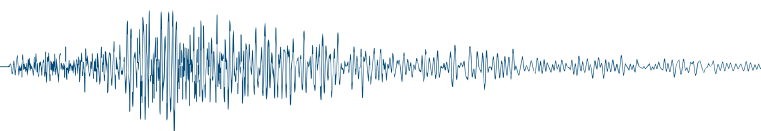
With the ASEG Conference in August fast approaching, let's all keep the Research Foundation and its essential role uppermost in our minds and use the occasion to commit to supporting this essential function of the ASEG.

Successful projects

Harrison Jones (Macquarie University). Supervisor Mark Lackie, industry monitor Mike Smith: *Geophysical Study of a Silurian Base Metal Occurrence west of Numeralla in New South Wales*.

This research will be based on a geographic area near Cooma, NSW with the following objectives:

- Investigate how the detailed geophysics relates to the geology of the area at the local and the prospect scale;



- Determine petrophysical measurements for basement units; and
- Ascertain the usefulness of different geophysical techniques in highlighting features of base metal deposits in the Numeralla area.



The Palaeozoic terrain of NSW is generally well mineralised and is host to many large copper, gold, lead, zinc, silver deposits; some of which are extremely important to the economy of the state. The mineral potential of the Silurian belt of metavolcanics and metasediments in the southern Monaro is, however, still to be determined.

Historically the Silurian belt has had base metal producing mines, and characterisation of mineralisation in the region may well aid exploration programs. This study will employ a variety of geophysical methods, including magnetic, gravity, electrical and electromagnetic techniques. These will be employed over known surface indicators of base metal and precious metal mineralisation to determine the applicability of these respective methods to exploration and to assess the size and extent of possible sub-surface mineralisation in the target area. Areas of particular interest include the Rosebank Mine and surrounds, where gossan and rock chip samples have given significant gold indicators as well as strongly anomalous silver, lead, zinc, copper, barium, bismuth, arsenic and molybdenum. In addition, to the east of the Rosebank Mine dump, two previous drill holes will be investigated based on pyritic black shale extractions as a comparison with the mineralised site.

Harrison graduated from Macquarie University in 2015 with a Bachelor of Science double majoring in Geology and Geophysics. He is currently continuing his studies undertaking a Bachelor of Philosophy/Masters of Research (BPhil/MRes) again at Macquarie University.

His professional vision is to expand his knowledge of the mineral and energy resources industry and to strive towards a successful career utilising geophysics and geology. Harrison's other personal interests include sports (mainly basketball), outdoor activities generally, reading, travelling and meeting new people.

Zubair Ahmed (Curtin University). Supervisor Maxim Lebedev: *Rock Characterization using Physical Methods on Powders.*



Continuous monitoring of the petrophysical properties of subsurface rocks that are being penetrated during drilling is important to the drillers at the rig site. Core samples can provide these properties but they are costly to acquire and time consuming to measure and analyse. Moreover, cores can be missing or broken. To overcome these drawbacks it is proposed to develop a new concept that relies on the drill cuttings that come up during drilling. Ultrasonic measurement on these rock powders with successive pressure levels can give the effective dynamic elastic moduli of the powder pack. These dynamic moduli can be inverted to get the elastic moduli of the constituent grains of the rock. The same procedure will be applied to core pulps and solid cores to compare the results.

Zubair Ahmed's PhD project is sponsored by DET CRC. His research interest lies in studying elastic waves to identify and analyse mechanical properties of the rocks and minerals that have significant influence on economically potential deposits. Prior to starting his doctoral study, he completed a Master of Science in Applied Geophysics from Chiang Mai University, Thailand and Bachelor of Science in Geology from University of

Dhaka, Bangladesh. He has been working in the oil and gas industry as a geophysicist for more than five years. His expertise includes seismic data acquisition line designing, field data quality control and seismic data interpretation.

Xuiyan Ren (RMIT). Supervisor Jim Macnae, industry monitor Jovan Silic: *3D Time domain EM modelling and inversion with finite volume method.*



First, we aim to implement the OcTree method to speed up forward modelling. Next we aim to implement the methodology defined by supervisor Macnae in providing good starting models for 3D inversions. Testing and reporting of the inversion results on Australia airborne EM data will advance interpretation methodology. The outcome will lie in improved capability to automatically fit geologically sensible 3D models to AEM data.

A joint project with Jilin University, China permits PhD student Ren to spend one year of her PhD at RMIT University, subject to receipt of a Chinese Government award, the results of which are imminent. Ren has already coded in China a forward modelling algorithm using the staggered grid finite volume method. Xuiyan is fascinated by geophysics and has received seven individual scholarships and 11 other awards and prizes for excellence in her undergraduate and graduate studies to date. She has already co-authored six refereed publications. Her supervisor in China is Professor Chang Chun Yin, familiar to many mining geophysicists from his time with Fugro Airborne Surveys in Canada.

Afzal Iqbal (University of Western Australia). Supervisor Julien Bourget, industry monitor David Moffat: *Tectono-*

stratigraphic evolution and petroleum prospectivity of the Roebuck Basin: insights from a 3D Seismic megasurvey.



This project is focussed on describing and mapping the basin scale regional structural framework and the impact of tectonic events on the depositional system and tectono-stratigraphic architecture of Roebuck Basin by using state-of-the-art methodologies. High resolution, three-dimensional structural and stratigraphic mapping at basin-scale will have significant impact in evaluating the petroleum prospectivity and in targeting new deeper prospects in the largely underexplored Roebuck Basin, only recently established as a promising oil and gas province.

Afzal Iqbal graduated from University of The Punjab – Pakistan in 2001 with a BSc – applied geology (1999) and MSc (2001) in petroleum geology. After working five years with Landmark Resources at various locations in Middle East and Pakistan, he joined Chevron International in mid-2006. Afzal held various positions in geoscience disciplines at Chevron International in the Middle East and Australia till the end of 2015. He has now joined the Centre for Energy Geoscience at UWA where his PhD research focuses on the tectono-stratigraphic evolution of the Roebuck and Canning basins, offshore Western Australia.

Roman Beloborodov (Curtin University). Supervisor Maxim Lebedev, industry monitor Marina Pervukhina. *Correlation of geomechanical and petrophysical properties of shale rocks – Extrapolation of laboratory core measurements on the borehole using well-log data.*

This project aims to develop an algorithm for the extrapolation of the laboratory measured geomechanical core properties



and anisotropy parameters to the whole length of the shale intervals in the borehole. The complexity of shale mineralogy, in-situ conditions and, finally, scaling effects make this task challenging.

Comprehensive laboratory investigation of synthetic and natural shale rocks along with the numerical modeling are required to understand the correlation between petrophysical and geomechanical properties of these rocks. State-of-the-art data mining and artificial neural network techniques are to be implemented for the analysis of wireline logs and linking them with the data acquired in the laboratory.

This approach will allow upscaling core properties on a borehole, and predicting of the geomechanical properties and anisotropy parameters of shales using the wireline logs. Outcomes of this study will make the exploration techniques more informative to cope efficiently with the common safety drilling issues, to choose the suitable methods of hydrocarbon extraction, and to ensure the operative tying of seismic surveys to well-log data.

Roman has graduated from Lomonosov Moscow State University (MSU) with a BSc in Hydrogeology and Engineering Geology, and a MSc in Soil Science and Artificial Lithogenesis. As a research fellow at MSU he was involved in multidisciplinary fieldwork on geothermal fields of Kamchatka Peninsula studying properties of geothermal clay rocks with geomechanical, chemical and physical methods. This work formed the basis for his MS thesis. For three years Roman worked in industry as an engineer-geologist, with a variety of duties from field and laboratory data acquisition and processing to supervision and quality control of engineering-geological surveys. As an intern at CSIRO (Perth), Roman

was involved in a commercial project on shales characterisation by conducting the physical and numerical modeling of shale rock properties. When he isn't working hard in the laboratory, he spends time with his family, goes for cycle rides, learns new languages and improves his programming skills.

Hamish Stein (University of Melbourne). Supervisor Stephen Gallagher, industry monitor Jarrod Dunne: *Geological and rock-physical considerations for building shallow elastic property models in deep-marine settings (NW Shelf, Australia).*



Modern geophysical imaging projects lack geological context and often undervalue or ignore proper rock physical constraints, especially when building complex high velocity models of the shallow overburden. Geophysical models have developed highly sophisticated migration algorithms, which have advanced ahead of our ability to provide accurate velocity models. As a result current methods tend to approximate velocity data, especially in the shallow overburden, and use methods that are not tied to or driven by, readily available geological and rock-physical knowledge.

The recent International Ocean Drilling Program (Expedition 356) campaign on the NW Shelf of Australia, has collected abundant information over the shallow Neogene strata in the form of logs, core, pressures, temperatures, etc. Analysis will initially focus specifically on the relationship between sonic velocity, vertical effective stress and lithology. When integrated with the regional seismic data and geological understanding (sequence stratigraphy, tectonics) it may be possible to build a predictive model for elastic parameters in the Neogene

for the entire north-western margin of Australia.

Born and raised in Perth, Hamish moved to Melbourne in 2010 in order to undertake a Bachelor of Commerce at the University of Melbourne. Majoring in Economics and Management, Hamish graduated in 2013, and moved to London where he spent time gaining experience in the finance industry, interning first at Hannam & Partners and then at Ophir Energy in the M&A departments. In 2015 Hamish returned to Melbourne to undertake a Graduate Diploma in Geology, before transitioning into the two-year MSc. program in 2016. Hamish was inspired to study geology following his time working in London with a largely resource sector focus, he hopes to develop a strong technical background through his studies to compliment his commercial experience. Outside of his studies Hamish is a keen hockey player, currently playing in the Victorian Premier League with the University of Melbourne Hockey club.

Lee Tasker (University of Western Australia). Supervisor Jeffrey Shragge, industry monitor Mads Toft: *4D Monitoring of Civil Infrastructure using Multichannel 3D Ground Penetrating Radar.*



The aim of this project is to develop a 4D-monitoring tool using multichannel 3D GPR technology to scan and image infrastructure over calendar time to enhance and improve the ability to accurately identify, interpret and monitor structural defects: (1) cracking and/or voiding present within infrastructure; and (2) volumetric changes of regions experiencing structural deformation. As a result of this research geophysicists will be able to provide Civil and Asset Management Engineers with a more accurate infrastructure-monitoring tool and geophysical data to better understand

the material behaviour of their infrastructure over calendar time. These near-surface geophysical tools will prove most useful in the planning and prioritising of long-term maintenance of an infrastructure, saving time, money and improving the overall safety management of the infrastructure.

Lee Tasker is a PhD student at the University of Western Australia (UWA) and a Geophysics Consultant with Draig Geoscience. He specialises in near-surface geophysics, with a focus on geophysical solutions to engineering problems. Lee has a Master of Physics (MPhys) from Cardiff University, UK and a Graduate Diploma in Science (GradDipSci) in Geophysics from Victoria University of Wellington (VUW), NZ. With over eight years of professional geophysical consulting experience, he has worked both nationally and internationally on projects in the engineering geophysics, environmental, heritage and exploration fields in Australia, Mongolia, New Zealand, Pakistan and Papua New Guinea. Lee also serves as the Western Australian Members' representative on the ASEG Near-Surface Geophysics Group. He received an ASEG WA Student Award in December 2015.

2015 Annual Report on TESEP (Teacher Earth Science Education Programme)



Jill Stevens
TESEP Chair
cp@tesep.org.au

Thanks to the significant Principal level funding by PESA, Platinum level funding from the Minerals Council Australia, ASEG, and ExxonMobil, Gold level funding from the AIG, DSD (SA) and Silver level funding from the AusIMM and ANU (RSES), 2015 has been another rewarding year for TESEP presenters as well as recipient teachers. Continued, overwhelmingly, positive feedback from teachers has reinforced the TESEP team's keen determination for delivery of a quality teaching programme to secondary teachers at as many east-central Australian locations as possible.

Making a difference in the classroom – is there still a need?

1. After eight years of intensive TESEP workshop (& fieldtrip) delivery with:
 - 1836 teacher attendances at 144 workshops in 30 locations, and
 - 559 teacher attendances at 40 field/site visits.

Have we made a difference to Earth & Environmental Science teaching in the classroom?

Teacher feedback says YES.

The multiplier effect of each TESEP teacher influencing 2 to 5 other teachers' results in close to 600 000 students being impacted by TESEP EES teaching resources.

2. How does TESEP sit along with other earth science (e.g. Earth Science WA), Science Technology Engineering and Mathematics (STEM) and science by action programs?

Teacher feedback indicates that there is still a need for teacher PD training as delivered by TESEP in all eastern/central states and territories. Classroom-based training of teachers and students, as done by Earth Science WA (ESWA), is outside of the funding capabilities of TESEP. We will continue to teach the teachers via our mainstay: workshops, hands-on exercises, field/site visits and webinars.

3. In the current waning cycle in mining/energy resources industries is there still a need for TESEP?

***YES** we do still need to plan for replacement of the current aging earth science (and science) professional knowledge-base.*

New TESEP teacher attendees:

1. Many teachers are still only just joining the TESEP teacher network, after hearing a Science Teachers Conference TESEP 'taster talk'. In 2015, 155 teacher participants, attended TESEP conference taster talks (TESEP conference attendance was funded through an Australian Geoscience Council special fund). In the past 8 years there has been a TESEP booth, and taster talks have been run, at 28 science teacher (and geological) conferences.
2. Teacher feedback has resoundingly indicated that teachers, who have participated in TESEP professional development (PD) workshops, are more confidently and knowledgeably teaching Earth and Environmental Science at secondary school level.
3. TESEP teacher participants indicate that they are passing on their knowledge and TESEP materials to at least 1 to 3 other teachers at their school.
4. Some new TESEP participants are trainee teachers wanting to expand the depth and breadth of their Science teaching skill-set.

TESEP special projects:

1. Field/site visits – To give teachers that 'light-bulb moment', fieldtrips to key field exposures and site visits to university, geological survey and corporate laboratories, as well as site visits to museums, mine sites and international conference career presentations and industry exhibition halls have been added to the TESEP teaching experience. In 2015, a total of 57 teachers took part in field/site experience and 30 exceptional Science teachers of merit were invited from 5 states to travel to Victoria for an industry-led 3-day field excursion (Cape Liptrap & Gippsland field sites) and AAPG ICE/ASEG-PESA international conference. Articles on this field experience were distributed to partner society newsletters in September 2015.
2. Virtual Fieldtrip – using software developed by TESEP partner, University of Tasmania's Dr Michael Roach, field exposures can be brought

to the students in classrooms. Key field world-class field exposures can be rotated and investigated at semi-regional to macro scale and structural/stratigraphic relationships can be investigated from the school classroom. Virtual petrography of rock and minerals as well as details of strata, fossils and sedimentary structures can be analysed. Hobart-area field exposures are being trialed by TESEP in 2016 as a demonstration of this application.

3. Standardised Rock and Mineral Kits – plans to link these to the virtual field locations and have teaching exercises developed as a new tenth PD of 'The Challenging Earth' series of 9.
4. Case studies supplement (currently over 30 freely downloadable case studies from across Australia and across the Earth Science spectrum have been developed to supplement the Year 11–12 EES Textbook (developed by ESWA).
5. Plate Tectonics, as an overarching theme, has been used to promote TESEP nationally using a classroom A2-sized gloss-finish poster, drafted and designed by AusIMM's Alison Potter for TESEP. Copies of this poster are now hanging in many classrooms across the country, as a colourful visual display, to enquiring young minds, of the inter-relationship between Earth's natural and physical resources and our use of the planet.
6. New fieldtrip guides for teachers and students have been developed for the Mt Gambier region, SA and for Cape Liptrap region, Vic.
7. Demonstration of the Exploration Seismograph exercise (funded by ASEG) (using donated geophones, standard teacher laptop and TESEP DVD film) at Labtech & Science Teacher conferences and PD venues.
8. Collaboration with new and existing partners – museums, universities, societies, corporates – to develop new and interesting teaching materials.

National Science Curriculum roll-out continues:

2014 through to 2017 are critical years for the new national Science curriculum roll-out. 2015 has seen the continuation of Year 8 (Rocks, Minerals & Mining – PD1) and Year 9 (PD9 Plate Tectonics) rolled out in all states and territories. In the 2015–2017 period, Year 10 and elective years 11 and 12 will include groundwater, climate-change and energy/resources of TESEP PD themes.

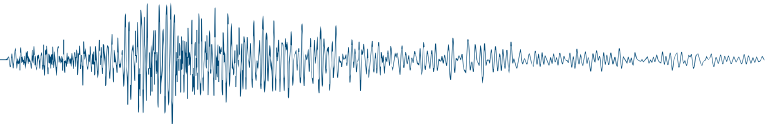
Earth and Environmental Science is now a significant part of junior, middle and senior Science and many teachers now teaching EES, (many only with biology, geography, environmental science and mathematics backgrounds), are challenged to learn and then teach their students on the themes of Earth and Environmental Science in the new curriculum.

That is why continued funding of TESEP presenters and developers to enable enthusiastic teachers to gain new knowledge using this teaching resource material, is so important. Slower times in the energy/resources industry have seen a drop-off of several corporates and some universities and government funding for TESEP.

2015–2016 has seen ongoing collaboration with:

- Australian Science Teachers Association (ASTA), who administer TESEP, and assist in web portal facilitation for webinars, standardisation for national-ready classroom material and accreditation of PDs, and provide national and state-based conferences for TESEP to present materials for teachers and network with teachers, as well as newsletter networks.
- Scienceworks/Planetarium and Museum Victoria (Melbourne), Australian Museum (Sydney), QMEA (PDs across Qld), VSSEC Space Centre (Strathmore, Vic) have provided venues and teaching materials that complement TESEP PD presentations and allow teachers guided access to exhibitions to which they may take students in future classroom excursions.
- Earth Science WA (ESWA), Earth Ed (Vic) and Geoscience Pathways Program (SA) share materials, presenters and fieldtrip developers.
- Geoscience Pathways website webmaster funding (shared by PESA & ASEG) – this site is used to upload TESEP PD material for teachers to have free download access.
- Minerals Council Australia (Vic) re addition of more mine site tours to TESEP PDs.

TESEP team thank all partners for their support to TESEP in 2015 and look forward to ongoing collaboration in this national EES teacher education program. Inquiries: Jill Stevens (Chair) cp@tesep.org.au or Greg McNamara (Executive Officer) eo@tesep.org.au.



TESEP teaches geoscience on the beaches and at the cliffs; in the classroom and on the playgrounds. The programme will continue.