

Education Matters



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New travel grants announced for geoscience

The Australian Geoscience Council and the Australian Academy of Sciences have announced a generous Travel Grant Scheme for sponsorship of 'early career' geoscientists for conferences and study. In announcing the program AGC President Dr Bill Shaw said it is part of the Council's recently published strategic plan to raise the profile of geoscience in Australia.



Dr Bill Shaw, President of the Australian Geoscience Council.

The funding has become available following the highly successful 34th International Geological Congress (the

quadrennial 'Olympiad' of the Earth Sciences), which was held in Brisbane in August 2012. The conference represented a huge organisational effort by geoscientists from universities, Geoscience Australia, state surveys and industry. Investment of the conference surplus is expected to fund the Travel Grant program for many decades.

Bill Shaw supplied *Preview* with some further details, indicating that these travel grants may be used to participate in professionally organised geoscientific conferences or conventions, undertake field work in appropriate areas, visit and work with appropriate international experts, or inspect appropriate mines or other geoscientific features such as type localities. There will be around five grants made available each year of between \$2000 and \$5000.

Further details and application forms are available online at www.agc.org.au. The inaugural round of applications for travel in 2016 closes on 31 October 2015.

The International Geological Congress (IGC) cycle allows us to establish the literary equivalent of a 'time capsule'. I remember that at the previous IGC held in Australia (Sydney, 1974), I and a few other of my senior colleagues were graduate students and members of a team of slaves populating an information desk. In 2012 I had somewhat more of a policy role as ASEG President. We will be watching our current student cohort for suitable organisers for another 'IGC Olympiad' in about 2050.

A challenge to geoscientists today: what are the predicted or hoped-for breakthroughs in geosciences before that next IGC in Australia? Let me know, and I'll build a list. I'll start the ball rolling with an item: a quantitative understanding of natural cycles relative to anthropogenic forcings in climate-change modelling. Now it is your turn.

Advance notice – *Preview* summary of the geophysics theses of 2015

In keeping with practice from previous years, *Preview*'s December edition will run a sampling of project titles and

abstracts of theses completed in the current year. Make sure you are included! I prefer that supervisors aggregate this information and forward it to me but, if in doubt, students should send me individual items. You never know when your abstract is going to catch the eye of an interested colleague or employer!

SEG and EAGE Distinguished Lecturer Presentations

As advertised in the June and August issues of *Preview*, the following presentations are scheduled in November. See the ASEG calendar in this issue or go to the ASEG website for further details.

18 November – Perth; 19 November – Adelaide; 23 November – Brisbane; 30 November – Hobart; 9–10 November – Canberra:

Hansreudi Maurer, Professor of ETH exploration and engineering geophysics at ETH Zürich, Switzerland, is the SEG's 2015 Near Surface Honorary Lecturer. His topic is 'The curse of dimensionality in exploring the subsurface, with particular application to tomographic inversions of 2D and 3D seismic data.'

<http://www.seg.org/education/lectures-courses/honorary-lecturers/2015/maurer/abstract>

20 November – Perth, and 25 November – Canberra:

Alessandro Ferretti, CEO of Tele-Rilevamento Europa, Milan, Italy, is the EAGE's visiting lecturer in its international continuing education and training program. His topic is 'Satellite InSAR data: reservoir monitoring from space'; a one-day seminar in radar interferometry (InSAR), which is becoming a standard tool for monitoring surface deformation phenomena. This EET course is intended as a guided tour of InSAR and its applications.

<http://lg.eage.org/?evp=10266>



Australian Society of
Exploration Geophysicists



Australian Specialist's Travelling Education Programme (OzSTEP)

4D seismic reservoir monitoring

Date: October 2015

Who Should Attend: Managers and staff on development and production asset teams; geophysicists, geologists, and reservoir engineers; any others with a science or engineering background, including university students, who are interested in time-lapse techniques to monitor fluid flow in the earth.

Instructor: Prof David Lumley, UWA

David Lumley is a Winthrop Professor and Chair in Geophysics, jointly appointed to the School of Physics, and School of Earth & Environment, at the University of Western Australia (UWA). He is also the founding Director of the UWA Centre for Energy Geoscience research. Prof. Lumley has published 150+ refereed journal papers and expanded abstracts, and is the lead or senior Chief Investigator for over \$130 Million in competitive research grants. He is a physicist with a focus on geophysical energy and environment applications, with prior research and operations roles in industry (including Chevron Research), and academic institutions (including Stanford University, PhD '95, and the University of Southern California). David has significant business owner experience as the Founder and Chief Scientist of 4th Wave Imaging Corp., a 4D seismic technology company purchased by Fugro in 2007. Prof. Lumley actively participates with international scientific societies such as ASEG, SEG and AGU, where he has served as a chairman and organizer of various scientific committees and workshops, and was elected as First Vice President of the SEG (2009-10) representing 35,000 members worldwide. David has served as an international Distinguished Lecturer for the SEG, SPE and AAPG societies, and has received several scientific honors including the first SEG Karcher Award for his "pioneering work in developing time-lapse 4D seismology" to image subsurface fluid flow. Prof. Lumley serves as an expert adviser to industry and government organizations, including the Western Australia state government for regional exploration and development of hydrocarbons, geothermal energy and CO₂ storage, and the US National Academy of Sciences.

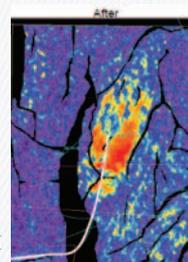
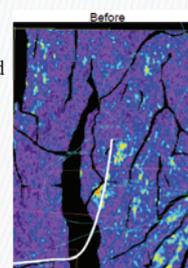


Course Outline:

This 1-day course is a practical overview of the most important theory, concepts and methods used in the modeling, design, acquisition, processing and quantitative interpretation of time-lapse 4D seismic data. Lecture topics include:

- 4D Rock and Fluid Physics, and various approaches to time-lapse 1D/2D/3D Seismic Modeling, to quantify how physical changes in the reservoir respond as changes in seismic data. This is useful for predicting the strength of the 4D signal, designing 4D seismic surveys and processing flows to enhance 4D signal and reduce 4D noise, and quantitatively interpreting 4D seismic data in order to estimate changes in reservoir properties such as fluid saturation and pore pressure.
- 4D Seismic Acquisition and 4D Processing techniques, to quantify non-repeatable 4D noise and suppress it, and to enhance real 4D seismic signal in the reservoir.
- 4D Quantitative Interpretation techniques to detect and analyze reservoir fluid flow anomalies, and to quantify them in terms of changes in pressure/saturation and other reservoir properties, using both qualitative and quantitative methods, including inversion.
- Monitoring aquifer drive and injected fluids such as water, gas, steam and CO₂, locating bypassed hydrocarbons, identifying reservoir compartmentalization, and quantifying the hydraulic properties of faults (seals, leaks, baffles).
- Integration of 4D seismic information with geologic and engineering data to update the reservoir fluid flow model so that predictions of hydrocarbon recovery and fluid injection match the actual production data better ("4D seismic history matching").
- Time permitting... advanced 4D seismic topics including compaction, geomechanical stress, anisotropy, 4D FWI (full waveform inversion), passive and ambient noise seismology, 4D gravity.
- Many case study examples from around the world, both onshore and offshore, including primary depletion, water or gas injection, steam flood, and CO₂ storage.

**4D Seismic
Pressure Anomaly**





Australian Society of
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Australian Specialist's Travelling Education Programme (OzSTEP)

Potential fields: a (re)introduction for geophysicists and geologists

Date: October 2015

Who Should Attend: geophysicists who wish to update/expand their appreciation of the use of potential field techniques; geologists who use gravity and/or magnetic data in mapping, exploration or interpretation (or who should do so!).

Instructor: Bob Musgrave, Geological Survey of New South Wales

Bob Musgrave is the Research Geophysicist with the Geological Survey of NSW. Bob graduated with a BSc (Hons) from the University of Sydney in 1981, majoring in geology and geophysics. Bob went on to complete a PhD (1987) at the University of Sydney in palaeomagnetism. Bob's interests in tectonics, palaeomagnetism and magnetic petrophysics led him through post-doctoral fellowships at Victoria University of Wellington (1987), the Australian National University (1988-89), and the University of Tasmania (1989-91). Bob went on to join the Ocean Drilling Program, based at Texas A&M University (1991-93), and to date has sailed on 5 ODP/IODP expeditions, the most recent in 2014. Returning to Australia, Bob was a Senior Lecturer in geophysics at La Trobe University until 2003. Bob was then a Senior Research Fellow at Macquarie University, before joining the Geological Survey of NSW in 2005. Bob is currently also a Conjoint Senior Lecturer at the University of Newcastle and an Honorary Associate of the University of Sydney. Bob's initial interest in palaeomagnetism has broadened over the years into a diverse range of applications, from magnetostratigraphic dating and tectonics, to magnetic petrophysics studies of hydrocarbon migration, gas hydrate accumulation, and the relationship of mineralisation processes to remanence-dominated magnetic anomalies. His work with GSNSW has emphasized applications of magnetic and gravity studies, including novel data filtering and presentation, long-wavelength interpretation and integration with passive seismic datasets, and joint magnetic and gravity inversion of complex tectonic settings. His research has yielded more than 50 peer-reviewed publications.



Course Outline:

Prerequisites: basic geology. No prior geophysical training is necessary, and the maths will be kept "light", so the course should be accessible to all geoscientists – but there will be the opportunity for more sophisticated discussion for those with established skills in geophysics.

Session 1 - Basics:

- Course overview and scope
- Basic form of potential field anomalies
- Data acquisition
- Scalar, gradient and tensor data. Earth's gravity and magnetic fields

Session 2 - Physical properties :

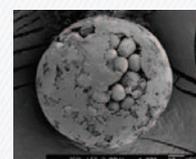
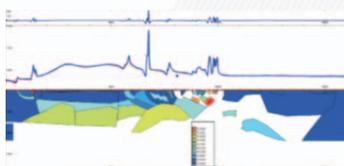
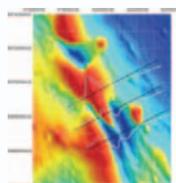
- Density and magnetic susceptibility
- Remanence
- Magnetic properties and mineralisation
- Microbes and magnetic diagenesis

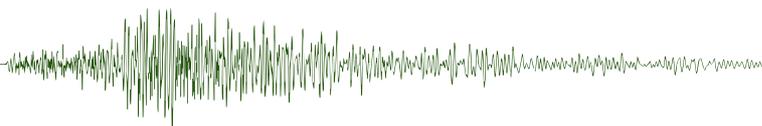
Session 3 - Data presentation and filtering :

- Derivative filters; phase filters and the tilt filter.
- Edge analysis ("worming").
- Euler depths; spectral depths. Curie depth.
- Isostatic correction.
- Tensor and gradient data interpretation.

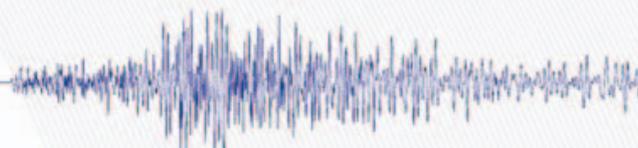
Session 4 - Potential field inversion :

- Source mapping; derivative maps; inferring lithology.
- Direct inversion, and its limitations.
- Geologically constrained inversion.
- Remanence and inversion.
- Case studies.





Australian Society of
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Australian Specialist's Travelling Education Programme (OzSTEP)

AVO and inversion methods in exploration seismology

Dates: 2nd Nov (Perth), 4th Nov (Brisbane) and 6th Nov (Melbourne)

Who Should Attend: Geoscientists with a solid background in exploration seismology who wish to broaden their knowledge of AVO and inversion methods and their applications.

Instructor: Dr Brian Russell

Brian Russell graduated from the University of Saskatchewan (BSc) in 1973 with a major in physics, and received a BSc (Hons) (1975) at the same university, a MSc in geophysics from Durham University (1978), U.K., and a Ph.D. from the University of Calgary (2004), all in exploration geophysics. He joined Chevron as an exploration geophysicist in 1976 and subsequently worked for Teknica and Veritas before co-founding Hampson-Russell Software with Dan Hampson in 1987. Hampson-Russell is now a subsidiary of CGG, where Brian is Vice President, GeoSoftware and a CGG Fellow. Brian is involved in the development of new AVO, rock physics, inversion and seismic attribute techniques as well as presenting courses throughout the world. He is a past-President of both the SEG and Canadian SEG (CSEG) and has received Honorary Membership from both societies, the CSEG Medal and the Cecil Green Enterprise Award from SEG. He is currently Chairman of the Board of the Pacific Institute for the Mathematical Sciences (PIMS), an Adjunct Professor in the Department of Geoscience at the University of Calgary and at the School of Energy Resources at the University of Wyoming, and is registered as a Professional Geophysicist (P.Geoph.) in the Province of Alberta.



Course Outline:

- Part 1: The rock physics basis of AVO and inversion
- Part 2: Post-stack seismic inversion and wavelet analysis
- Part 3: Pre-stack inversion and AVO methods and case studies.
- Part 4: Azimuthal amplitude and velocity analysis for fracture determination.
- Part 5: Stochastic inversion methods.
- Part 6: Applications to unconventional plays.