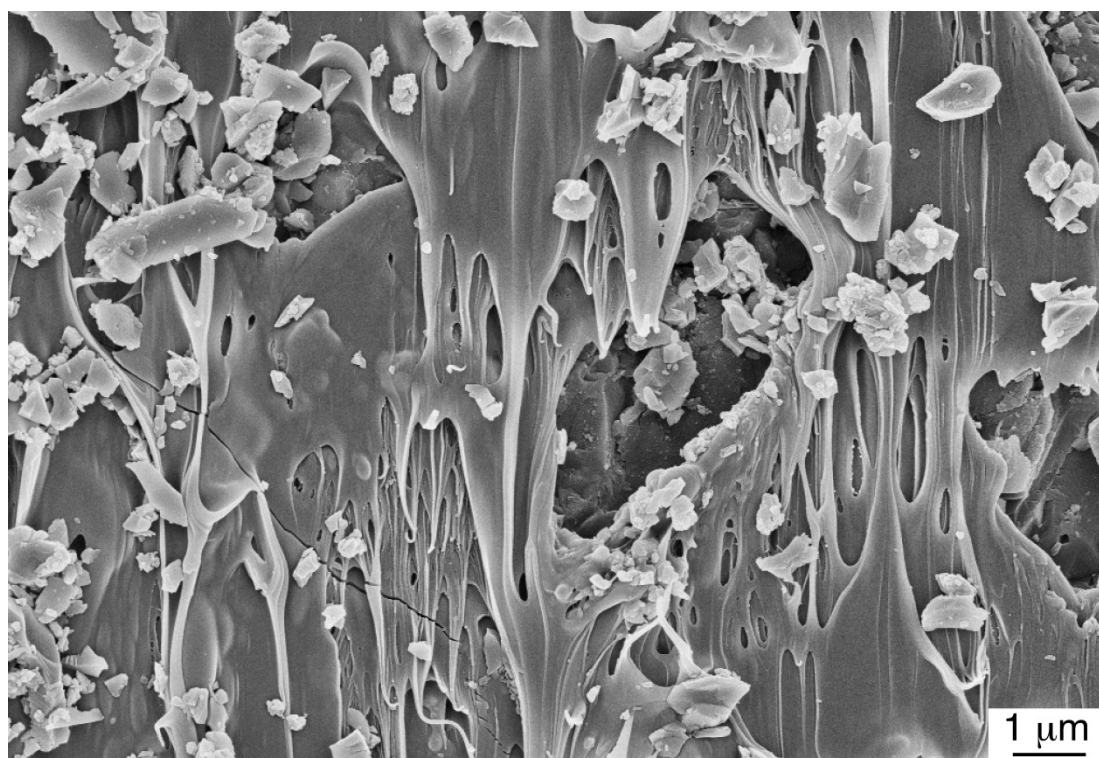


Research School of Earth Sciences Annual Report 2015



Microstructure of a melt layer formed by fast (seismogenic) slip on a quartz sandstone interface.

Photo Credit: Kathryn Hayward



Australian
National
University

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DIRECTOR'S REVIEW OF 2015

New Opportunities Building on Strengths

2015 has been a year of consolidating the School's financial position, exploring new opportunities to shape research directions, and new emphasis on creating and delivering a world-class education program. Professor Ian Jackson (outgoing Director) and Mr Geoff Pearson (Business Manager) have worked hard to place the School in a strong position to begin to shape the School's future through renewal of academic staff, maintaining resourcing of high quality research support, and the potential to consider new initiatives.

The School is well placed to continue to address the big questions that surround the origin and evolution, internal structure and dynamics, and the future environmental state of Earth using leading experimental, analytical, and computational methods. This capability is underpinned by our highly skilled professional and technical staff, and supported by the dedication of our administrative staff. The School's success is now more than ever reliant on its large cohort of almost 100 higher degree by research students who account for a large fraction our research output, and provide vitality to our workplace.

The School has made significant investments in the strength of its climate systems and seismology research programs through the hire of Dr Nerilie Abram and a position offer to Dr Caroline Eakin (subsequently accepted). Both are highly talented early career researchers.

A full review of the Earth and Marine Science undergraduate curriculum has been commenced under the stewardship of Assoc. Prof. David Heslop (Associate Director Education). The review is tasked with creating a distinctive undergraduate program that equals and contributes to the School's reputation as one of the world's leading research programs in Earth science. Building the national and international profile of our undergraduate education program is part of a more holistic approach to education and research, providing benefits from the integration of research and education, and facilitating the transition from student to practicing scientist and researcher. One of the centre pieces of the School's vision for Education is developing a new Masters of Earth Science (Adv) program. This program sits alongside the existing Honours program and is aimed at attracting high quality students from around the country and overseas to the ANU, and providing students with a more substantive research led experience and research thesis project and thereby also a better foundation for progressing to a postgraduate research degree.

The School is becoming increasingly aware of the need to diversify sources of research funding beyond ARC Discovery and Fellowship schemes as competition intensifies for dwindling pools of available funds. This has been further highlighted by the Watt Review released in November which recommends increasing the incentives for universities to engage with business and other end users of research. To ride the changing direction of funding the School will need to maintain its strengths in fundamental and pure research, build on these existing strengths and grow new research collaborations and networks.

Engaging with alumni and previous staff has become an important focus for the School in recent years and has been highly successful in re-forging many links, celebrating the School's achievements, and promoting the School's future. A

highlight of the 2015 calendar was the 90th birthday celebration event for our Emeritus Professors Ross Taylor and Mervyn Patterson, which attracted many past and current colleagues from around the world. Others include exposés on the William Smith Map, one of the School's treasures, through presentations to alumni and friends of the School by Emeritus Prof. Patrick DeDeckker. The year saw the successful launch of the Earth Sciences Future Fund driven by the initiative and patronage of Prof. Ian Jackson. The Earth Science Future Fund has already accumulated significant very generous donations from past and present staff, alumni and friends of the School. The Fund has been created with vision of generating new postdoctoral fellowships and other opportunities, particularly for early career researchers, postgraduate students, and undergraduate students.

The year saw the departure of Professors Joerg Herrmann, Daniella Rubatto, and Rainer Grün, Dr Giampiero Iaffaldano, and Associate Professor Graham Hughes, all long standing faculty members who have taken up new positions elsewhere. The School wishes each of them every success in their new endeavours and looks forward to maintaining ongoing and productive collaborations. Their contributions to the School's research, research training and teaching capacity will prove difficult to replicate.

The year also saw the retirements of Professor Ian Jackson, and Associate Professors Bear McPhail and Marc Norman. All are enjoying new found time to be more research active and are continuing to make significant contributions to the School's success. The retirements of Norm Schramm and Nigel Craddy have been acutely felt as long standing valued members of the School's professional staff, as have departures of Ben Jenkins, Jeremy Wykes, Jung Park, and Ratchaphum Khattiyakul who have taken up positions elsewhere, and Hashantha Mendis, whose web skills have proved impossible to replace.

In other staff news, the School was able to welcome Callum Shakespeare and Kial Stewart back to the Geophysical Fluid Dynamics group, who return with valuable experience and add further critical mass to the group. Postdoctoral and Research Fellows Oliver Nebel and Helen MacGregor have taken up their Future Fellowships at other Australian universities, Stephanie Downes a position at the ACE CRC in Tasmania, and Maureen Davies has returned to the University of Oregon.

The School enjoyed some bitter sweet success with ARC Discovery, with only a small number of grants awarded despite having a large fraction of highly ranked unsuccessful proposals just beneath the cut-off for funding. New grants were awarded to Assoc. Prof. Paul Tregoning, Prof. Andrew Roberts, Assoc. Prof. Jochen Brocks, Dr Rachel Woods and Prof. Stephen Eggins. The School is particularly proud of its three successful ARC DECRA Fellowship awardees, Drs Sophie Lewis, Guilherme Mallmann and Jonathan Pownall. This grant news was topped off by the successful rebid to ARC LIEF led by Professors Exon and Arculus, which was awarded \$10 million over 5 years, and will see the School continuing to host the office and cover the subscription and participation costs in the International Ocean Discovery Program.

A number of academic staff, ranging from early career researchers to senior professors received prestigious awards adding to the long list of prestigious award received by members of the School. Most notable of these were Dr Nerilie Abram who received the Dorothy Hill Award of the Australian Academy of Science, Dr Sophie Lewis the (ACT) Tall Poppy of the Year Award from the Australian Institute

for Policy and Science, Assoc. Prof. Andy Hogg the Nicholas P. Fofonoff Award of the American Meteorological Society, and Assoc. Prof. Richard Armstrong the Jubilee Medal Award of the Geological Society of South Africa. Professors Michael Roderick and Hugh O'Neill were elected Fellows of the American Geophysical Union, and Professor Malcolm Sambridge was elected a Fellow of the Australian Academy of Science.

I would like to finish off by thanking all staff and students for their strong commitment to the School and efforts through the year which continue to make the School such a stimulating place to work and learn, and to pursue our research endeavours.

A handwritten signature in blue ink, appearing to read 'S. M. Eggins', with a stylized flourish at the end.

Professor Stephen Eggins

STAFF, STUDENTS AND AWARDS

ACADEMIC STAFF

Director

I.N.S. Jackson, BSc Qld, PhD ANU, FAA (to 15/10/2015)

S.M. Eggins, BSc UNSW, PhD Tasmania (from 16/10/2015)

Associate Directors

Geochemistry G.M. Yaxley, BSc PhD Tasmania

Geophysics P. Tregoning, BSurv PhD UNSW

Ocean and Climate Geoscience

S.M. Eggins, BSc UNSW, PhD Tasmania (to 12/04/2015)

E. Rohling, BSc, MSc, PhD Utrecht (from 13/04/2015)

Higher Degree Research

D. Rubatto, BSc MSc Turin, PhD ETH Zürich (to 12/04/2015)

J.J. Brocks, Dip Freiburg, PhD Sydney (from 13/04/2015)

Education (Undergraduate and Coursework)

J. Hermann, Dip PhD ETH Zürich (to 12/04/2015)

S.M. Eggins, BSc UNSW, PhD Tasmania (13/04/2015 to 15/10/2015)

D. Heslop, BSc Durham, PhD Liverpool, Dr habil Bremen (from 16/10/2015)

Special Projects T.R. Ireland, BSc Otago, PhD ANU

Distinguished Professors

B.L.N. Kennett, MA PhD ScD Cambridge, FAA, FRS

H.St.C. O'Neill, BA Oxford, PhD Manchester, FAA, FRS

Professors

R.J. Arculus, BSc PhD Durham, FAIMM

I.H. Campbell, BSc UWA, PhD DIC London

S.F. Cox, BSc Tasmania, PhD Monash

S.M. Eggins, BSc UNSW, PhD Tasmania

N.F. Exon, BSc (Hons) NSW, PhD Kiel

R.W. Grün, Diplo Geol, Dr.rer.nat.habil Köln, DSc ANU, FAAH (to 15/10/2015)
J. Hermann, Dip PhD ETH Zürich (to 30/06/2015)
T.R. Ireland, BSc Otago, PhD ANU
I.N.S. Jackson, BSc Qld, PhD ANU, FAA
G.S. Lister, BSc Qld, BSc (Hons) James Cook, PhD ANU
B.J. Pillans, BSc PhD ANU, HonFRSNZ
A.P. Roberts, BSc Massey, BSc (Hons) PhD DS Victoria University (Wellington)
M.L. Roderick, BAppSc QUT, PGDipGIS Qld, PhD Curtin
E. Rohling, BSc, MSc, PhD Utrecht
D. Rubatto, BSc MSc Turin, PhD ETH Zürich (to 30/06/2015)
M.S. Sambridge, BSc Loughborough, PhD ANU, FAA, FRAS
I.S. Williams, BSc PhD ANU

Senior Fellows

Y. Amelin, MSc PhD Leningrad State University
R.A. Armstrong, BSc MSc Natal, PhD Witwatersrand
V.C. Bennett, BSc PhD UCLA
A.J. Berry, BSc (Hons) Sydney, DPhil Oxford
J.J. Brocks, Dip Freiburg, PhD Sydney
M.J. Ellwood, BSc (Hons) PhD Otago
C.M. Fanning, BSc Adelaide
M.K. Gagan, BA UCSantaBarbara, PhD James Cook
A.M. Hogg, BSc ANU, PhD UWA
M. Honda, MSc PhD Tokyo
G.O. Hughes, BE ME Auckland, PhD Cambridge
R.C. Kerr, BSc Qld, PhD Cambridge, FAIP
C. Lineweaver, BSc Munich, PhD Berkeley
J.A. Mavrogenes, BS Beloit, MS Missouri-Rolla, PhD Virginia Tech
S.C. McClusky, BSurv PhD NSW
D.C. McPhail, BSc. (Hons) MSc British Columbia, PhD Princeton (to 8/07/2015)
M.D. Norman, MSc Tennessee, PhD Rice (to 10/03/2015)
H. Tkalčić, Dip Engineering in Physics, Zagreb, PhD California Berkley
P. Tregoning, BSurv PhD UNSW
G.M. Yaxley, BSc PhD Tasmania

Fellows

N.J. Abram, BSc Advanced (Hons) Sydney, PhD ANU
D.R. Davies, MSc PhD Cardiff University, UK
S.J. Fallon, BA MS San Diego, PhD ANU
M.A. Forster, BSc MSc PhD Monash
D.C. Heslop, BSc Durham, PhD Liverpool, Dr habil Bremen
M.A. Kendrick, BSc Edinburgh, PhD Manchester
P.L. King, BSc (Hons) ANU, PhD Arizona State
H.V. McGregor, PhD ANU (to 1/04/2015)
O. Nebel, Diplom Geology Dr rer. nat. Munster (to 1/03/2015)
B.N. Opdyke, AB Columbia, MS PhD Michigan
R. Strzepek, BSc McGill, PhD British Columbia (to 14/03/2015)
J. Yu, BSc MSc Nanjing University, PhD Cambridge

Research Fellows

J. Avila, BSc MSc UFRGS, PhD ANU
N. Balfour, BSc (Hons) MSc Victoria University (Wellington), PhD University Victoria (British Columbia)
L. Chang, BSc Peking, PhD Southampton (to 12/10/2015)
M. Davies, MSc Washington, PhD Oregon State (to 16/01/2015)
J. Dettmer, Dipl. Geophys. University of Hamburg (Germany), PhD University of Victoria (British Columbia, Canada)
S. Downes, BSc (Hons) UNSW, PhD UTas (to 25/04/2015)
B. Gayen, PhD UC San Diego, USA
G. Iaffaldano, BSc Rome, PhD Munich (to 1/06/2015)
C. Le Losq, MSc, PhD IPGP, France (from 1/10/2015)
S. Lewis, PhD ANU
M. Louvel, PhD ETH Zurich (to 1/05/2015)
A. Purcell, BSc (Hons), PhD ANU
E. Saygin, BEng Istanbul Technical University, PhD ANU
C. Shakespeare, B.Sc (Hons) ANU, PhD Cambridge (from 1/08/2015)
K. Stewart, (from 15/04/2015)
R. Wood, BSc (Hons) Durham, MSc DPhil Oxford (from 9/02/2015)

Postdoctoral Fellows

S. Allgeyer, PhD Paris Diderot University, France
A. Benard, BSc (Hons) IUEM, Brest, France, MSc IPGP, Paris, PhD University of Saint-Étienne and LMV
A. Burnham, MSci MA Cambridge, PhD Imperial College London
E. David, BSc, MSc École Normale Supérieure, Paris, PhD Imperial College London
K. Grant, BSc Southampton, MSc JCU, PhD Southampton
B. Hejrani, BSc Kurdistan, MSc Tehran, PhD Aarhus University, Denmark
S. Kim, BSc, MSc, PhD Seoul National University
A. Koulali, PhD Rabat Agdal University, Morocco
C. Krause, BSc (Hons) Macquarie University (from 11/05/2015)
L. Lescarmontier (to 2/05/2015)
G. Marino, MSc (cum laude) University 'Federico II' of Naples; PhD Utrecht University
J. Pownall, MEarthSci Oxford, PhD Royal Holloway University of London
C. Sippl, Dipl.-Geophys. UMunich, PhD FU Berlin
J. Stipcevic, Diploma of Engineering in Physics, PhD Zagreb (to 15/04/2015)
P. Tollan, MSci University of Bristol, PhD Durham University

Emeritus Academics

K.S.W. Campbell, MSc PhD Queensland, FAA
J.M.A Chappell, BSc MSc Auckland, PhD ANU, FAA, HonFRSNZ
W. Compston, BSc PhD DSc (Hon) WAust, FAA, FRS
P. DeDeckker, BA MSc (Hons) Macquarie, PhD DSc Adelaide
R.A. Eggleton, BSc (Hons) Adelaide, PhD Wisconsin, DSc Adelaide
D.J. Ellis, MSc Melbourne, PhD Tasmania
J.D. Fitzgerald, BSc James Cook, PhD Monash
D.H. Green, BSc MSc DSc DLitt (Hon) Tasmania, PhD Cambridge, FAA, FRS
R.W. Griffiths, BSc PhD ANU, FAIP, FAA
I.N.S. Jackson, BSc Qld, PhD ANU, FAA (from 16/10/2015)
K. Lambeck, BSurv NSW, DPhil DSc Oxford, FAA, FRS
I. McDougall, BSc Tasmania, PhD ANU, FAA
D.C. McPhail, BSc. (Hons) MSc British Columbia, PhD Princeton (from 9/07/2015)
M.D. Norman, MSc Tennessee, PhD Rice (from 11/03/2015)
M.S. Paterson, BSc Adelaide, PhD Cambridge, FAA

R.W.R. Rutland, BSc PhD London, FTSE

S.R. Taylor, BSc (Hons) MSc New Zealand, PhD Indiana, MA DSc Oxford, HonAC

J.S. Turner, MSc Sydney, PhD Cambridge, FIP, FAIP, FAA, FRS

Visitors

C. Alibert, MS Paris VII, first thesis ENS Paris, State thesis, CRPG, Nancy

L. Bean, BSc Sydney, DipEd Sydney Teachers College, GradDip ANU

R. Binns, BSc (Hons) Sydney, PhD Cambridge

R.V. Burne, BSc Wales, D.Phil Oxford

P.R. Cummins, BA Physics, PhD UC Berkeley

G.F. Davies, MSc Monash, PhD CalTech

P. de Caritat, PhD ANU

M. Duval, PhD University of Burgos, Spain

J. Foster, BSc Sydney, MSc, PhD ANU

G.M. Gibson, BSc Edinburgh, PhD Otago

R. Grün, Diplo Geol, Dr.rer.nat.habil Köln, DSc ANU, FAAH (from 16/10/2015)

R. Henley, BSc (Hons) London, PhD Manchester

L. Jacques, BSc (Hons) Western Australia, PhD Tasmania

P.J. Jones, BSc. London, MSc. ANU, PhD London

F.E.M. Lilley, BSc (Hons) Sydney, MSc, PhD University of Western Ontario

W. Mayer, BSc NZ, MSc (Hons) Auckland, PhD New England

R. Ranasinghe, BScEng Peradeniya, Sri Lanka, PhD Western Australia

J. Rogers, BSc. UK, BA ANU, BSc (Hons) ANU, PhD ANU

D.L. Strusz, B.Sc (Hons), PhD Sydney

E. Truswell, BSc (Hons) Western Australia, PhD Cambridge

Research Officers

A. Heerdegen, BSc (Hons) Massey, PhD ANU

P. Holden, BSc Lancaster, PhD St. Andrews

G. Luton, BSURV UNSW

H.W.S. McQueen, BSc Qld, MSc York, PhD ANU

R. Rapp, BA State University of New York, PhD Rensselaer Polytechnic Institute

M. Salmon, BSc (Hons) PhD Victoria University (Wellington)

R. Wood, BSc (Hons) Durham, MSc DPhil Oxford (to 8/02/2015)

Research Assistants

A. Arcidiaco, BAppSc GradDip SAIInst

J. Byrne, BSc (Hons) ANU, PhD Monash

J. McDonald, MPhil ANU (to 2/07/2015)

J. Shelley, BSc MSc University of Canterbury (NZ)

L. Rodriguez Sanz, BSc Venezuela, MEnvStudies, PhD Autonomous University of Barcelona

PROFESSIONAL STAFF

School Manager

G.F.M. Pearson, BA, BTh, MBA, FAIM

Executive Assistant to the Director and the School Manager

M. Farrer

Information Technology Manager

P. Davidson, BSc MSc Auckland, PhD ANU

Information Technology Officers

A. Boland, (to 22/01/2015)

D. Bolt, BSc Sydney

B. Harrold, BSc ANU

H. Mendis, BInfTec Deakin (from 23/01/2015 to 31/08/2015)

D. Pradhan, (from 7/12/2015)

Philanthropic Development Manager

M. King, DipTeach ACU, BA Deakin, GradDipRE ACU, MEd (Leadership) UNSW

PRISE Business Officer and School Projects Officer

B.J. Armstrong, BSc UNISA (South Africa)

Building and Facilities Officer

E. Ward, Cert V Frontline Management, Quest/ANU

Assistant Building and Facilities Officer

N. Craddy (to 16/01/2015)

Receptionist

T. Asher

Student Administrator HDR

M. Coldrick

Student Administrator Coursework and Honours

J. McDermid, BCom Victoria University (Wellington), MAppSc (Lib&InfoMgt) CSU

Cluster Administrators

M. Hapel - Geophysics

J. Magro – Geochemistry

K. Markmann – Leave cover (20/07/2015 to 10/11/2015)

R. Petch – Ocean and Climate Geoscience

IODP Administrator

C. Beasley

Electrical Engineering Workshop Manager

A. Latimore, BEng University of Canberra

Electrical Engineering Workshop

D. Cassar, AdvDipEng CIT

D. Corrigan

D. Cummins, AdvDipEng CIT

T. Redman, AssocDip(Elect Eng) CIT

H. Sasaki, AssocDip CIT

N. Schram, DipEIE SAIT (to 2/10/2015)

Mechanical Engineering Workshop Manager

A. Wilson, AssocDipMechEng CIT, Cert III Engineering (Mechanical) Trade

Mechanical Engineering Workshop

B. Butler, Cert III Mechanical Engineering Sydney Institute, Cert III Engineering-Mechanical Trade (Toolmaking)

D. Thomson, Cert-Fitting and Machining Trade (to 30/06/2015)

C. Were, AdDipMechEng CIT, Cert III Engineering (Mechanical) Trade

G. Woodward, Cert-Fitting and Machining Trade

School Laboratory Manager

J. Cali, BAppSc QIT

Technical Officers

D. Clark, Cert III Metal Fabrication AdvDipEng CIT

J. Cowley, BSc ANU

R. Esmay

B. Fu, BSc Chungchun, MSc Nanjing, PhD Vrije

H. Gao, BSc Wuhan University, MSc Zhongshan University

J. Hope, BSc JCUNO

B. Jenkins, BSc UTS, PhD ANU (to 26/06/2015)

R. Khattiyakul, (to 6/10/2015)

L. Kinsley, BSc GradDipSc ANU

H. Kokkonen, Certificate in Lapidary ACT TAFE, BAppSc Canberra College of Advanced Education

P. Lanc

Q. Li, BEng Beijing Electronic Science and Technology Institute, MEng UNISA

L. McMorrow, AssocDipSc NTU

H. Miller, AdDipMechEng CIT

J. Park, (to 21/02/2015)

S. Paxton, AssocDip AppliedGeoscience CIT , FGAA

A. Purelli, (from 20/04/2015)

S. Rayapaty, BEng Jawaharlal Nehru Technological University, MIT University of Canberra

A. Rummery

D. Scott, AssocDipMechEng CIT

H. Scott-Gagan, BSc Sydney

D. Thomson, Cert-Fitting and Machining Trade (from 1/07/2015)

B. Tranter, Cert II Auto Radiator Services John Batman Institute TAFE, Auto Climate Control/Air conditioning Casey Institute of TAFE

U. Troitzsch, Diplom Technische Universität Darmstadt, PhD ANU

D. Vasegh, AssocDeg Khajeh Nasireddin Toosi University of Technology (Iran)

J. Wykes, PhD ANU (to 4/03/2015)

X. Zhang, PhD LaTrobe

X. Zhao, BSc Jilin University, PhD Southampton

S. Zink, BSc Hanover, Diploma(MSc) Hanover

C. Zirk, BA Victoria University (Melbourne)

POST-GRADUATE STUDENTS

PhD Candidates

| | | |
|-----------------------------|--------------------|------------------------|
| Amies, Jessica | Hoffmann, Janosch | Papuc, Andreea |
| Andrew, Sarah | Holland, Katherine | Pejic, Tanja |
| Anenburg, Michael | James, Hannah | Pranantyo, Ignatius |
| Benavente Bravo, Roberto | Johnson, Emma | Prichard, Jennifer |
| Bobrovskiy, Ilya | Jollands, Michael | Rajabi, Sareh |
| Brenner, Alan | Jones, Timothy | Renggli, Christian |
| Bruisten, Benjamin | Kallenberg, Bianca | Samanta, Moneesha |
| Carr, Patrick | Kimbrough, Alena | Sapah, Marian |
| Castillo Gonzalez, Paula | Kirby, Rachel | Schoneveld, Louise |
| Chen, Mimi | Koefoed, Piers | Scicchitano, Maria |
| Chopping, Richard | Koudashev, Oleg | Sebastian, Nita |
| Cipta, Athanasius | Krause, Claire | Short, Michael |
| Cline II, Christopher | Lakey, Shayne | Sieber, Melanie |
| Cocker, Helen | Li, Yang | Skelton, Richard |
| Connolly, Clare | Liu, Li | Smith, Tegan |
| Crisp, Laura | Loiselle, Liane | Snow, Kate |
| Dai, Yuhao | Long, Kelsie | Sommer, Johanna |
| David, Anthony | Lowczak, Jessica | Stephenson, Joanne |
| De Leon, Andrea | Manceau, Rose | Stott, Rachel |
| Doull, Matthew | Mare, Eleanor | Tambiah, Charles |
| Ducommun-Dit-Verron, Joelle | Martin, Hayden | Tian, Siyuan |
| Ellis, Bethany | Masoumi, Salim | Timmerman, Suzette |
| Emetc, Veronika | McAlpine, Sarlae | Tolley, James |
| Eriks, Nicole | McConnochie, Craig | Tynan, Sarah |
| Fang, Fang | Meyerink, Scott | Valetich, Matthew |
| Gauthiez-Putallaz, Laure | Mondal, Mainak | Vasilyev, Prokopi |
| Gibson, Angus | Moore, Michael | Vreugdenhil, Catherine |
| Goodarzi, Patrick | Mustac, Marija | Ward, Josephine |
| Gueneli, Nur | Naguit, Muriel | Whan, Tarun |
| Haber, Thomas | Nand, Vikashni | Williams, Morgan |
| Hao, Hongda | Nash, Graham | Willmes, Malte |
| Harazin, Kathleen | O'Kane, Tomas | Wu, Jiade |
| Hawkins, Rhys | O'Neill, Cameron | Wurtzel, Jennifer |
| Haynes, Marcus | Owens, Ryan | Zannat, Umma |

Stotz, Ingo (withdrew 18/6/2015)

PhD theses completed (Supervisor in parentheses)

Brentegani, Luna "Coccolithophores in sediments from offshore Australia: pre and post-industrial species distribution and calcification" (Brad Opdyke)

Chopra, Aditya "The origin and evolution of life on a pale blue dot: astrophysical, geochemical and biological constraints on habitability" (Charley Lineweaver)

Gowan, Evan "Model of the western Laurentide ice sheet, North America" (Paul Tregoning)

Hossen, Md. Jakir "New perspectives on tsunami source inversion" (Phil Cummins)

Ingham, Elizabeth "Exploring geomagnetic field behaviour during polarity reversals and excursions" (Andrew Roberts)

Jarrett, Amber "Biogeochemical evolution in the Neoproterozoic Amadeus Basin, central Australia" (Jochen Brocks)

Komugabe, Aimee "Mid- to late- Holocene environmental changes in the southwest Pacific: records from deep-sea black corals" (Stewart Fallon)

Pachhai, Surya "Bayesian inference for deep earth structure using body waves and free oscillations of the Earth" (Hrvoje Tkalčić)

Richardson, Laura "Water mass connectivity and mixing along the southern margin of Australia: hydrographic and stable isotope analyses" (Brad Opdyke)

Roberts, Jenna "A multi-disciplinary assessment of endocrine disrupting chemicals, pharmaceuticals and personal care products in Australia's largest inland sewage treatment plant and the Molonglo/Murrumbidgee effluent-receiving environment" (David Ellis)

Rosso, Isabella "Sub-mesoscale dynamics in the Southern Ocean" (Andy Hogg)

Sagar, Stephen "Inversion of remote sensing data in a shallow water environment using a trans-dimensional probabilistic framework" (Malcolm Sambridge)

Scroxton, Nicholas "Late Pleistocene climate and environment from speleothems Flores, Indonesia: vegetation, volcanoes and *Homo floresiensis*" (Michael Gagan)

Sossi, Paolo "Petrogenesis of ultramafic rocks and an experimental and natural investigation of non-traditional stable isotope fractionation at high temperatures: implications for the chemical evolution of the earth and planets" (Hugh O'Neill)

Strzepek, Kelly "Deep-sea coral amino acid archives of marine ecosystem function in east and southeast Australian waters" (Stewart Fallon)

Thompson, Claire "Characterising copper biogeochemistry in marine systems" (Michael Ellwood)

Zhukova, Irina "Diffusion and solubilities of selected trace elements in olivine" (Ian Campbell)

MPhil Candidates

Burne, Robert
Higgins, Andrew
Leonard, Yosafat
Thorne, Jane

MPhil thesis completed (Supervisor in parentheses)

Hayward, Kathryn "The strength and mechanical behaviour of quartz slip interfaces:
An experimental investigation" (Stephen Cox)

Master of Earth Sciences (Advanced)

This new program was offered for the first time during 2015.

Flanigan, Michaela
Hurt, Lynton
Joshi, Niranjana
Liyanage, Tharika
Shi, Lyn
Tuveng, Karina
Yin, Fan
Zhang, Xinyue

UNDERGRADUATE STUDENTS

Honours completions

Twenty students completed Honours in 2015.

Undergraduate Education Course Numbers

| Semester 1 | Course name | Convenor | Number of students |
|---------------|--|-----------------------------|--------------------|
| EMSC1006/6107 | Blue Planet | Penny King & Nick Engerer | 116 |
| EMSC2012/6031 | Introduction to Structural & Field Geology | Stephen Cox | 23 |
| EMSC2014/6014 | Sedimentology & Stratigraphy | Brad Opdyke | 21 |
| EMSC2017/6017 | Rocks and Minerals | Greg Yaxley | 33 |
| EMSC3002/6030 | Structural Geology & Tectonics | Stephen Cox | 15 |
| EMSC3023/6023 | Marine Biogeochemistry | Mike Ellwood & Steve Eggins | 20 |
| EMSC3024/6024 | Magmatism & Metamorphism | Joerg Hermann | 20 |
| EMSC3032/6032 | Melting Polar Ice Sheets | Paul Tregoning | 12 |
| EMSC8706 | Natural Hazards | Phil Cummins | 9 |
| Winter | | | |
| EMSC3001 | Field Geology | Kathryn Hayward | 9 |
| | | | |
| Semester 2 | | | |
| EMSC1008 | Earth | Andrew Berry | 64 |
| EMSC2015/6015 | Chemistry of the Earth | Ian Williams | 15 |
| EMSC2019/6019 | Geobiology | Jochen Brocks | 30 |
| EMSC2021/6021 | Climate System Science | Mike Roderick & Andy Hogg | 21 |
| EMSC3007 | Economic Geology | John Mavrogenes | 13 |
| EMSC3022 | Planetary Science | Charley Lineweaver | 43 |

| | | | |
|---------------|--------------------------|----------------|----|
| EMSC3025/6025 | Groundwater | Brendan Hanger | 35 |
| EMSC3027/6027 | Palaeoclimatology | Jimin Yu | 12 |
| | | | |
| Spring | | | |
| EMSC3019 | Coral Reef Field Studies | Brad Opdyke | 15 |

| | | | |
|----------|----------------|--|---|
| EMSC3050 | Special topics | | 5 |
|----------|----------------|--|---|

STAFF HONOURS & AWARDS

| NAME | AWARD | AWARDING BODY |
|-----------------------------|---|---|
| Dr N.J. Abram | Dorothy Hill Award | Australian Academy of Science |
| A/Prof. R. Armstrong | Jubilee Medal Award | Geological Society of South Africa |
| Dr D.R. Davies | Strategic Communications and Public Affairs Award | The Australian National University |
| A/Prof. A. Hogg | Nicholas P. Fofonoff Award | American Meteorological Society |
| Dr S.C. Lewis | Early Career Research Award | Australian Meteorological and Oceanographic Society |
| Dr S.C. Lewis | Tall Poppy of the Year Award | Australian Institute for Policy and Science |
| Prof. H.StC. O'Neill | Fellow | American Geophysical Union |
| Prof. B. Pillans | Honorary Life Fellow | International Union for Quaternary Research (INQUA) |
| Prof. M.L. Roderick | Fellowship | American Geophysical Union |
| Prof. M. Sambridge | Fellow | Australian Academy of Science |

STUDENT HONOURS & AWARDS

Higher Degree Research

Allan White Scholarship

DA Brown Travel Fellowship

Jaeger Scholarship

Mervyn & Katalin Paterson Fellowship

Nicole Eriks

Jennifer Wurtzel

Rachel Kirby

Yang Li and Michael Short

| | |
|--|-------------------|
| Ringwood Scholarship | Michael Anenburg |
| Robert Hill Memorial Prize | Jenna Roberts |
| Sue Kesson Scholarship | Mike Jollands |
| Biennial conference of the Specialist Group in Structural Geology and Tectonics of the Geological Society of Australia: Best student oral presentation | Kathryn Hayward |
| Australian Space Research Conference: Best student poster presentation | Christian Renggli |

Coursework

| | |
|--|------------------------------------|
| A L Hales Honours Scholarship | Heather Layzell |
| Scholarship in Regolith Science | Tharika Liyanage and Hamish Leitch |
| RSES Masters Scholarship | Michaela Flanigan |
| ANU University Medal | Rachel Kirby |
| Janet Elspeth Crawford Prize | Rachel Kirby |
| Victorian Space Science Education Centre: Australian Space Science Prize for best Honours student in Geology and Planetary Geology | Rachel Kirby |



Mrs Denise Hales presenting the 2015 Hales Scholarship to Heather Layzell, while Vice Chancellor Professor Ian Young AO looks on. Photo credit: Adam Da Cruz

RESEARCH ACTIVITIES

EXPERIMENTAL PETROLOGY (Group leader: Hugh O' Neill)

The Experimental Petrology group uses a laboratory-based experimental approach combined with field observations to study the Earth, its origin, evolution and mineral wealth. The group operates a wide range of experimental devices for generating the high temperatures and pressures that are needed to reproduce the natural conditions within the Earth. The equipment includes high temperature furnaces capable of reaching 1800°C, equipped for precise control of oxygen and sulfur fugacities by gas mixing, 11 solid-media piston-cylinder devices for generating pressures to 6 GPa and temperatures in excess of 2000°C, a multi-anvil apparatus for achieving pressures of 26 GPa and a well-equipped hydrothermal laboratory. In addition the group runs an array of microbeam analytical techniques, including a Cameca SX100 electron microprobe for major element analysis, laser-ablation ICP-MS for trace element and isotopic analysis and FTIR spectroscopy for the determination of H₂O, CO₂ and other volatile species. The experimental apparatus is supervised and maintained by two Technical Officers who also ensure compliance with occupational safety guidelines. The electron microprobe is also run by a dedicated manager. The laser-ablation laboratory saw a succession of temporary technical operators on an ad-hoc basis before Dr Peter Tollan took charge at the end of the year.

The group in 2015 had 14 PhD students using the high-temperature, high-pressure facilities, plus a number of Honours and two MSc students. Four PhD students graduated during the year.

The group started the year with six continuing academic staff, as defined by those whose activities were centred around the experimental and analytical laboratories run by the group, namely Profs. Arculus, Hermann and O'Neill, and A/Profs. Berry, Mavrogenes and Yaxley, but has been sadly depleted by the loss of Prof. Jörg Hermann, who departed to the University of Bern, Switzerland and Prof. Richard Arculus, who retired. Neither has yet been replaced. Among post-doctoral fellows, Dr Marion Louvel went to a new post-doctoral position in Bristol, Dr Philipp Brandl returned to Germany, while Dr Charles LeLosq arrived from the Geophysical Laboratory of the Carnegie Institute of Washington. A former student from the group, Dr Guilherme Mallmann, will make a welcome return in 2016 to take up an ARC DECRA Fellowship. The group also benefits from hosting a number of distinguished Visiting Fellows engaged in collaborative research projects with academic staff and students.

Funding for a new electron microprobe totaling \$1.6 M was secured through ARC LEIF (in 2014) and ANU Major Equipment funding schemes by a team led by Dr Greg Yaxley. After careful investigation into required specifications, a tender will go out in 2016. Two new computer-controlled piston-cylinder apparatus configured to a new RSES design were commissioned, and two more are in preparation. The computer control marks a useful advance in high-pressure experimentation for its

improvement in the accuracy with which pressure can be measured. Several other laboratories in Australia and internationally have expressed interest in their design. Further funding for laboratory equipment was secured through an ARC LIEF grant to Dr John Mavrogenes and Prof. Hugh O'Neill, which will be used to rebuild Dr Mavrogenes' hydrothermal laboratory and to commission a new ultra-high-pressure piston cylinder. The group failed to win any new ARC Discovery grants in the 2015 round, which will have an adverse impact on its operations and future directions.

Research continues into the experimental study of trace-element partitioning, and characterization of Fe and several trace-element valence states by XANES spectroscopy at the Australian Synchrotron. Use of this national facility has become an important part of the group's research, so it was reassuring to learn in 2015 that funding support for the AS will continue forward on a secure basis.

Among the diverse activities undertaken by the surviving members of the group and their students, Greg Yaxley continued high-pressure experimental investigations of the fate of carbon in deeply subducted, altered mafic oceanic crust. Experiments by PhD student Melanie Sieber have investigated the carbonation of the cold serpentinite wedge above the fore-arc region of subduction zones by hydrous, CO₂-bearing fluids liberated from the slab. Fixing of carbon as magnesite in a talc-bearing

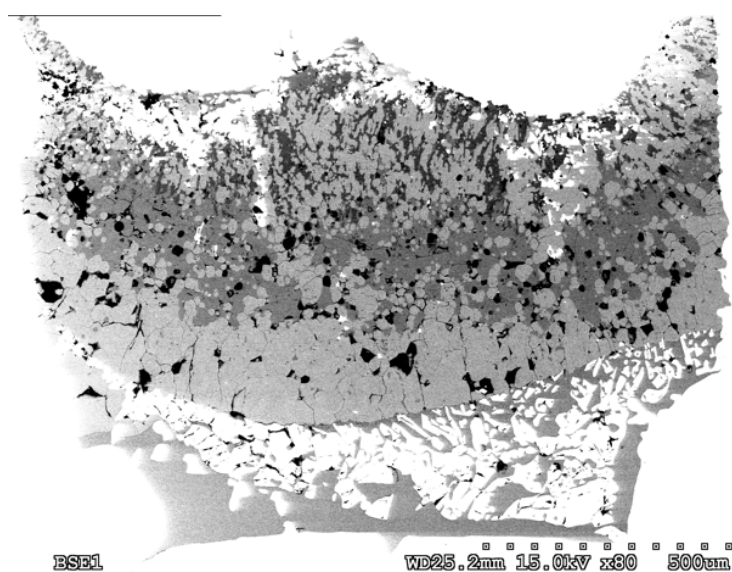


Figure 1. Back-scattered electron image off multi anvil experiment (13GPa, 1200°C) on a basalt + calcite composition, showing stishovite (dark grey) + garnet (mid-grey) + clinopyroxene (light grey) + carbonate melt (homogenous grey area at bottom of image) with rhenium (IV) oxide buffer (white).

assemblage may result in development of a formerly unrecognised carbonate reservoir in the mantle, which could significantly influence carbon fluxes into the deeper mantle. Multi-anvil experiments are examining partial melting of carbonate eclogite subducted to lowermost upper mantle and mantle transition zone depths, and interactions of the resulting carbonate melts with reduced peridotite to form diamonds and hybrid silicate

Andrew Berry continued to use synchrotron radiation to investigate the speciation of redox variable elements and undertook experiments at the Advanced Photon Source in Chicago (the oxidation state of Fe in peridotitic garnet), European Synchrotron Radiation Facility in Grenoble (the oxidation state of Fe in eclogitic garnet) and

Diamond Light Source in Oxfordshire (characterisation of a new material for the removal of As from drinking water). He also spent a month as a Professor-Researcher at the Institut de Physique du Globe de Paris working with Daniel Neuville on the properties of silicate melts.

Hugh O'Neill has developed a method to parameterize Rare Earth Element pattern shapes with applications to basaltic magmatism and experimentally is working on the solubilities of Platinum Group Elements in silicate melts. His student, Paolo Sossi, who graduated in 2015, has measured isotopic fractionation of Fe among the major minerals of the mantle and has investigated the effect of cooling rates on the extent of disequilibrium in the compositions of olivines crystallizing from komatiitic liquids. His students and co-workers continue to measure diffusion of trace elements in olivine (Mike Jollands and Irina Zhukova), trace-element partitioning between plagioclase, clinopyroxene and silicate melts (Louise Schoneveld), the effect of pressure on trace-element partitioning through changes in structure and coordination in silicate melts (Eleanor Mare) and to study the complexities of how H₂O substitutes into olivine (Pete Tollan and Rachel Stott) in order to understand better the deep Earth geochemical cycle of H₂O. A new project to determine the phase relations of sulfide under mantle conditions as a function of pressure, temperature and oxygen fugacity (Johanna Sommer) has started.

John Mavrogenes has been investigating the generation of porphyry copper deposits by gas-brine reaction in volcanic arc, and, with Marion Louvel, has applied X-ray absorption spectroscopy using synchrotron radiation to study the hydrothermal controls on the genesis of REE deposits.

Visiting Fellow Dick Henley is working with Penny King in a new field of geochemistry: systematics of heterogeneous gas reactions (chemisorption) at high temperatures, with applications in the fields of planetary and meteorite chemistry, volcanic processes and the origin of major metal accumulations such as porphyry copper deposits.

GEODESY AND GEODYNAMICS (Group leader: Paul Tregoning)

In 2015 the Geodynamics and Geodesy group comprised 6 academics, one senior manager, 6 PhD students and one M. Phil. student. The research undertaken predominantly uses satellite observations to study changes on Earth, as well as using ground-based geomorphological observations to construct models of ice sheets to represent the deglaciation cycles of the Earth.

The group saw the departure of Dr Lydie Lescarmontier who returned to France after several years in Australia. Two PhD students, Michael Moore and Bianca Kallenberg, submitted their PhD theses during 2015. Michael has returned to the Geodesy group at Geoscience Australia, while Bianca is still at RSES working on firn compaction modelling for mass balance studies of East Antarctica. Both Veronika Emetc and Siyuan Tian successfully passed their mid-term PhD examinations during 2015.

Siyuan and Veronika have made significant progress in their studies. Siyuan presented results of her assimilation of soil moisture observations (from the SMOS mission) and total water storage (from the GRACE mission) into hydrological modelling at the 21st International Congress on Modelling and Simulation at the Gold Coast in December 2015. Veronika presented results of her modelling of fracture processes in glaciers at the 2nd National Geodesy Workshop held at RSES in December. Salim Masoumi (PhD student) also presented his results on modelling of atmospheric gradients using GPS observations at the National Geodesy Workshop.

Crustal deformation studies using GPS focused on Eastern Indonesia in 2015, with Simon McClusky and Achraf Koulali participating in one of several field campaigns during the year. We derived a new block model for the deformation of eastern Indonesia (Koulali et al., GRL, *in revision*). Several active zones were identified, including the Semau Fault (west of Timor) and the transfer of convergence from the subduction zone south of Indonesia to the back-arc thrust system spanning over 2000 km from north of Java through to the Wetar Thrust in the east (Figure 1). The results highlight a significant seismic threat for eastern Java as well as demonstrating the risk of major earthquakes – and associated tsunamis – for Bali, Lombok and other coasts along the Flores Sea.

Progress in cryospheric studies included further development of a monthly firn compaction model (Figure 2) and refinements of the North American Ice Sheet to account properly for realistic ice sheet topography and the presence of melt lakes. An assessment of the most recent global glacial isostatic adjustment (GIA) model, ICE-6G_C (VM5), has shown significant issues remain in regions of marine-grounded ice sheets. A new model to remove GIA from space gravity estimates of mass balance change will be made publicly available (Purcell et al., 2015).

The in-house software to analyse the GRACE observations has continued to advance. Several improvements were made in the parameterization of the mascon elements used to describe the gravity field on the surface of the Earth. A solar radiation pressure model for the satellites (including thermal re-radiation effects) was

developed to aid in the calibration of the onboard accelerometers. Dr Sebastien Allgeyer joined GRACE team in the latter half of the year as part of the current ARC Discovery project funding this research.

Dr Simon McClusky successfully raised funds to acquire a fixed-wing drone to provide a new capability of deriving local digital elevation models (DEMs). After appropriate training, Simon and Dr Herb McQueen have now used the drone to provide information on palaeo-lake shorelines of Lake George and also in the Lake Mungo area (western NSW) to support an ongoing ARC archaeology and geomorphology project (see Figure 3).

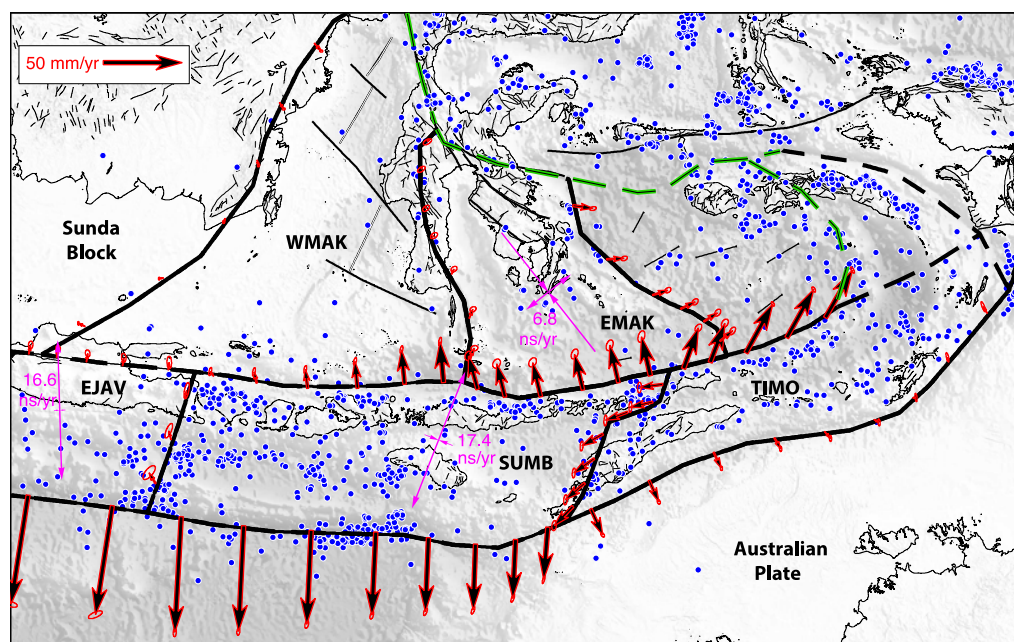


Figure 1. The kinematic block model of Koulali et al. (2015) for eastern Indonesia. Blue dots show the locations of earthquakes, black lines represent the locations of block boundaries. The arrows show the predicted relative motions on the block boundaries.

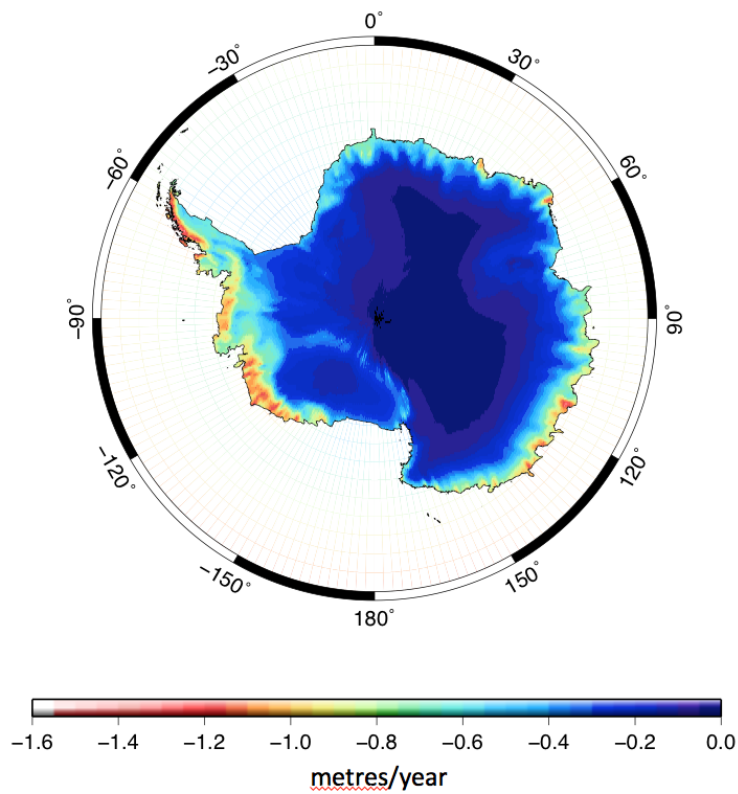


Figure 2. Rate of reduction of ice surface height over Antarctica due to firn compaction. This effect must be accounted for when using satellite altimetry estimates of rates of change of ice heights to calculate mass balance changes in Antarctica.



Figure 3. Dr Herb McQueen launching the new fixed-wing drone for a flight over Lake Mungo. The data collected allows a DEM of the area to be generated with a height accuracy of ~ 1 cm.

GEOPHYSICAL FLUID DYNAMICS (Group leader: Andy Hogg)

In Brief

- Graham Hughes is departing the GFD group for a Professorship at Imperial College, London, after 18 years of service. Graham's GFD legacy is his major contributions to the development of our laboratory, and particularly a series of Horizontal Convection experiments that have redefined the oceanographic community's understanding of the overturning circulation.
- Adele Morrison awarded the Uwe Radok prize for the best Australian PhD thesis, awarded by the Australian Meteorological and Oceanographic Society (AMOS).
- Sophie Lewis awarded a DECRA Fellowship to begin in 2016.
- Andy Hogg received the Fofonoff award from the American Meteorological Society and the Priestley Medal from AMOS.
- Kial Stewart and Callum Shakespeare joined the group as Postdoctoral Fellows.
- Isa Rosso graduated from her PhD; Mainak Mondal and Angus Gibson joined the group as new PhD students.

Research Highlights

The GFD group conducts research into fluid processes relevant to the earth system. Current research priorities include oceanic convection, ice-ocean interactions and the large-scale circulation of the ocean.

Convection is flow that arises in response to buoyancy forcing (e.g. cooling at the ocean surface). Most studies on geophysical convection use forcing which has a simple form, such as a unidirectional gradient in heating/cooling over the domain. We have recently applied forcing on a length scale smaller than the domain, and with variation in both horizontal directions (Griffiths & Gayen, 2015). Direct numerical simulations have shown turbulence throughout the domain, plume merging, a regime transition to a dominant domain-scale circulation, and a region of logarithmic velocity in the boundary layer, despite zero net heat flux through the boundary (see Figure 1). The results support the hypothesis that the key driver of turbulent convection is the production of available potential energy without necessarily supplying total potential energy. Thus, large-scale convectively-driven circulation in the oceans may be driven by small scale variations in surface forcing.

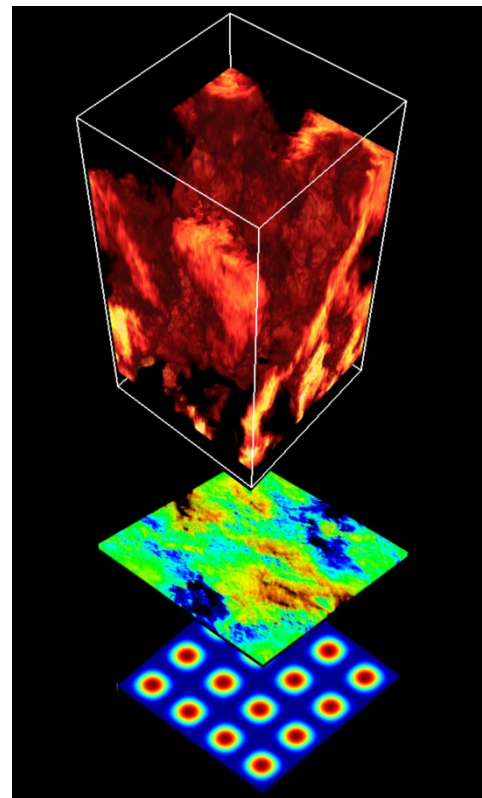


Figure 1. Snapshots of numerical simulation of convection. From the bottom: temperature distribution imposed on the boundary (red: hot, blue: cold), horizontal sections showing velocity component horizontal direction at mid-depth, and, at the top, 3D maps of vertical velocity.

The rate of melting of the polar ice sheets comprises the largest uncertainty in predicting future sea level rise. During 2015 we have continued our experimental and theoretical work into understanding the dynamics of convective meltwater plumes that form next to Antarctic and Greenland ice shelves – and control the speed at which the ocean can melt the ice (Kerr & McConnochie, 2015). A theoretical model has been developed to describe the meltwater plume, while the effect of ocean stratification on ice-ocean interactions has been explored experimentally. Stratification significantly reduces the ice melt rates and the meltwater plume velocity. Direct numerical simulations have been used to show that a sloping ice face will alter the heat and salt transport to the ice, and hence the melt rate.

Circulation in the Southern Ocean remains poorly understood and undersampled by observations, yet is one of the fastest changing regions on the planet. A major obstacle to progress in Southern Ocean research has been the role of fine scale processes such as eddies and jets in controlling the large-scale circulation; these processes are difficult to model and observe. We now have strong observational evidence (using satellite altimetry; Hogg et al. 2015) that the intensity of these eddies has increased over the last two decades. Furthermore, we can unambiguously attribute these eddy increases to increases in the magnitude of westerly winds that drive the Southern Ocean.

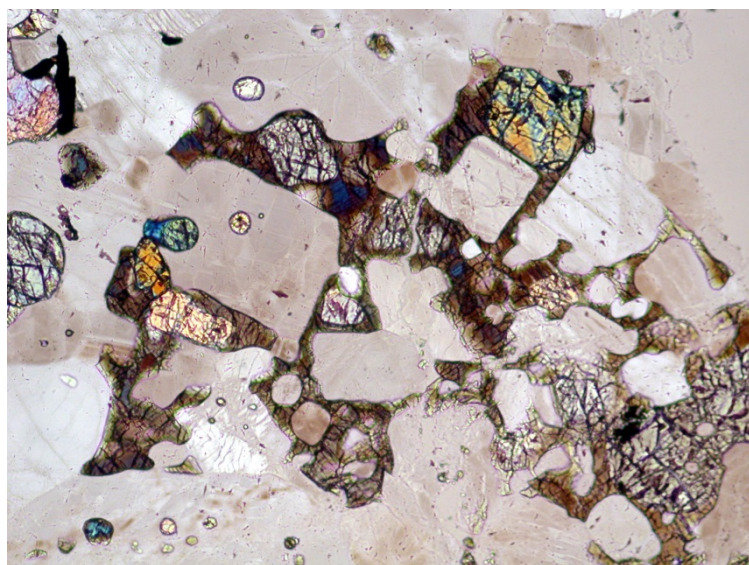
In the far southern reaches of the Southern Ocean, dense water is formed on the Antarctic shelves through a combination of cooling and salinification. This water then cascades off the shallow shelves down to the abyssal ocean (see <https://youtube/8VMSF28J9H4>) to form a water mass known as Antarctic Bottom Water. Recent observational evidence has indicated that Antarctic Bottom Water is becoming less saline and less cold; and therefore less dense. The reduction in deep ocean density has the potential to alter the global circulation and ocean carbon budget, but the processes controlling this change are unknown. We have shown that this water mass formation process is primarily sensitive to the changes in the buoyancy forcing at the ocean surface, such as warming or freshening through the meltwater from Antarctica (Snow et al. 2015). Our studies have emphasised the importance of ocean circulation on the Antarctic shelf in controlling the abyssal ocean response to climate change, and this a future research priority for our group.

ISOTOPE GEOCHEMISTRY (Group leader: Vickie Bennett)

The research activities within the Isotope Geochemistry group span the extremes of the geologic timescale, from the study of rare pre-solar grains preserved in meteorites pre-dating the beginning of the solar system more than 4.5 billion through to high precision age determinations of young volcanoes, and in scale from planetary systems to individual molecules. Active areas of research within the Isotope Geochemistry area include planetary and early Earth studies, metamorphic and igneous geochemistry, the role of fluids in crustal processes and the elemental cycling from atmosphere to the deep Earth interior. The diverse faculty and research activities under the Isotope Geochemistry banner are linked through reliance on the development and application of novel analytical methods and instrumentation for isotopic measurements, with a strong network of collaborations and student co-supervision throughout the group.

Research Highlights:

2015 was another exciting and productive year. Notable advances for instrument development were the installation on the multi-collector noble gas mass spectrometer Helix-MC of a new source assembly and high gain Faraday amplifier with $1\text{E}13$ ohm feedback resistor. These upgrades improved accuracies of noble gas analyses significantly in M. Honda's lab and are leading to new types of investigations. Under the direction of Trevor Ireland, the SHRIMP SI is continuing to make good progress measuring minor stable isotope abundances, including the rare isotopes ^{17}O in meteoritic materials and ^{36}S in Archean sulphides. Central to work has been the development of a new detection system by the RSES Electronics Group based on charge accumulation.



Optical photomicrograph of a 4.2 Ga lunar breccia illustrating a texture produced by slow cooling of a melt followed by mild annealing. The rock consists of plagioclase, olivine, and pyroxenes. Abundant Fe-metal and chondritic relative abundances of highly siderophile elements in this sample indicates it is a lunar impact melt. Field of view is ~ 1 mm wide. Photo: M. Norman.

Isotope Geochemistry faculty and students continue high rates of publication in international journals. Highlights of the past year include the work of Ian Williams to

produce and publish over 2,500 conodont oxygen analyses from over 160 rock samples to define in more detail than ever before the rise and fall of global sea surface temperatures throughout the Silurian (J. A. Trotter, I. S. Williams, et al., New conodont $\delta^{18}\text{O}$ records of Silurian climate change: Implications for environmental and biological events, *Palaeogeography, Palaeoclimatology, Palaeoecology* 443 (2016) 34–48).

Marc Norman's work showed that the petrology, mineral chemistry, and well-defined crystallization age of a noritic anorthosite impact melt rock from the Moon shows that a basin-scale impact occurred on the Moon at 4.2 Ga. This shows that the late heavy bombardment on the Moon was more prolonged than a single episode at 3.9 Ga (M. D. Norman, et al., (2015) Crystal accumulation in a 4.2 Ga lunar impact melt. *Geochimica et Cosmochimica Acta*, vol. 172, pp. 410-429. DOI: 10.1016/j.gca.2015.09.021).

Vickie Bennett was part of a team synthesizing observations from the oldest rocks worldwide to put together a new model for an early supercontinent (Nutman, A.P., Bennett, V.C., and Friend, C.R.L.F., Proposal for the continent Itsaia amalgamated at 3.66 Ga and rifting apart from 3.45 Ga: Evidence and mechanism for a Wilson cycle at the start of the rock record. (2015) *American Journal of Science* 315 (6), 509-536.)



PhD student Joelle Ducommun (Supervisor Mark Kendrick) leading fieldwork in the Sultanate of Oman. Joelle is standing in front of a large pillow basalt that is part of the Oman ophiolite complex.

Group members maintained high levels of international professional service with notable examples being Marc Norman continuing as Executive Editor of the leading geochemistry journal *Geochimica et Cosmochimica Acta*, overseeing 90 associate editors and 1000 new manuscript submissions per year; Trevor Ireland as Vice-President of the Meteoritical Society; Vickie Bennett is the Early Earth theme chair for the 2016 Goldschmidt conference, Yokohama Japan and the Chair of the Awards Nomination Committee of the Geochemical Society.

Faculty and students of Isotope Geochemistry area are active in the newly formed

SSERVI Australia, which is a node of the NASA Solar System Exploration Research Virtual Institute and contributed to the Planetary Science Workshop held at RSES on 28 September. SSERVI Australian aims to strengthen national planetary research and extend collaborations with the international community through SSERVI and NASA (www.sserviaustralia.org).

PhD student Suzette Timmerman (Supervisor M. Honda) presented an invited talk on multiple inclusion ages in diamonds at the Goldschmidt Geochemistry conference in Prague. Our PhD students excelled at the ANU-wide “3 Minute Thesis” competition Hannah James reaching the finals and with Kelsie Long winning second place (both supervised by Ian Williams).

Education

Isotope Geochemistry faculty continue to increase their teaching profiles with Ian Williams taking over as convener of the 2nd year course EMSC 2015 “Chemistry of Planet Earth” and with new faculty member Mark Kendrick contributing 50% of the lectures to a highly revised course. Vickie Bennett and Yuri Amelin prepared and delivered the new Master’s level course EMSC 8022, “Analytical Geochemistry” in 2nd semester.



Master’s students in the new EMSC 8022 “Analytical Geochemistry” course and lecturer Yuri Amelin don their “bunny suits” in preparation for an introduction to the isotope geochemistry clean laboratory.

Staffing Changes

We welcomed new PhD students Suzette Timmerman (Supervisor M. Honda), Li Liu and Lianne Loiselle (Supervisor Trevor Ireland).

We congratulate Marian Sampah on submission of her PhD thesis (Supervisors Trevor Ireland and Yuri Amelin).

On a sad note, in July we said farewell to Daniela Rubatto after 17 years as part of the SHRIMP group at RSES. Daniela leaves us to take up a Professorship at the

University of Bern, Switzerland. Her research and administrative leadership will be greatly missed, as will her energy and enthusiasm, but we look forward to visiting our new “international” colleague and working with her in the future.



Daniela Rubatto and family in their new home.

MARINE BIOGEOCHEMISTRY (Group leader: Michael Ellwood)

The marine biogeochemistry group at RSES has had a dynamic year. The group continues to focus on its research strengths to answer key research problems in marine science, e.g. What is the role the oceans in regulating global climate? How do changes in the bioavailability of trace metals shape the microbial community in the ocean? How do foraminifer and corals calcify? and, What was the physical and chemical state of the ocean during the last glacial period?

To address these questions a number of students, postdocs and academics went on field trips to undertake experiments and collect sample for analysis back at RSES. Field locations included: One Tree Island on the Great Barrier Reef, Puerto Rico, Subantarctic waters southeast of Tasmania.

The group continued to publish high impacting papers with notable additions to the prestigious journals: Nature, Science, and Proceedings of the National Academy of Sciences.

In 2015 some group members moved into new laboratory space within the Florey building. The building was completely refurbished and is now equipped with state-of-the-art laboratories for undertaking marine research. The RSES wing within the building includes a dedicated phytoplankton culture room, a clean room for trace metal research, a wet culture room for growing calcareous organisms including corals and foraminifera, and general laboratory facilities. These facilities are a welcome addition to the marine biogeochemistry group, and RSES as a whole.

Group members continue to contribute to the undergraduate teaching program within RSES. Courses taught by academic group members include: Marine biogeochemistry, Palaeoclimatology and Climate Change, Coral Reef Field Studies, Sedimentology and Stratigraphy and The Blue Planet.

The group also welcomed a number of new PhD students.



Field trip to One Tree Island in January 2015. Team members included (left to right) Aero Leplastrier, Bradley Opdyke, Russell Graham (Station Manager) and Stephen Eggins.

OCEAN & CLIMATE CHANGE (Group leader: Eelco Rohling)

The Ocean & Climate Change group researches a variety of ocean and climate change topics over different timescales, but mostly over the past 1 million years, using marine sediment cores. We perform an array of analyses in wide-ranging collaborations both within ANU and outside, with a strong international outlook. We routinely include probabilistic statistical analyses and quantitative assessments in our analyses results and interpretations. We collaborate with experts in Earth System, ice-sheet, and Glacio-Isostatic Adjustment modelling, and in geochronology and archaeology. Critical topics concern sea-level change, climate sensitivity, monsoon changes, impacts on biogeochemical cycles (especially the carbon cycle), and the processes behind organic-rich sediment deposition.

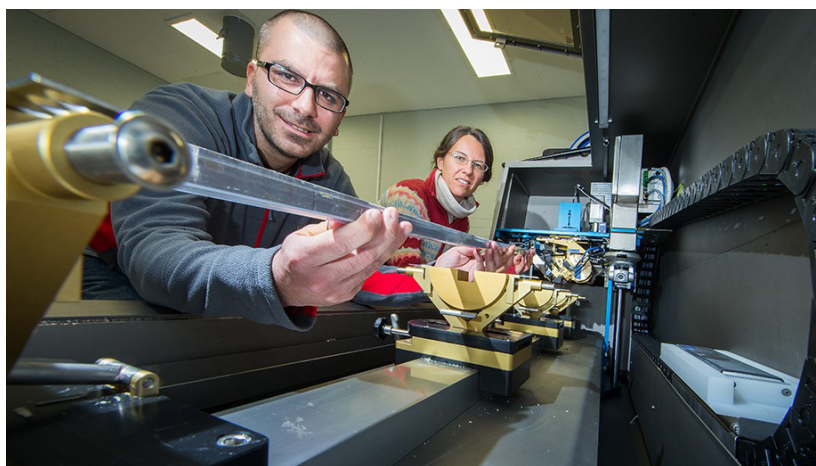
In 2015 the group comprised Prof. Eelco Rohling, Drs Katharine Grant, Gianluca Marino and Laura Rodriguez-Sanz, and PhD students Jess Amies, Alan Brenner and Rose Manceau. We also hosted visitors from Southampton (UK) for a couple of months each: Dr Fiona Hibbert and PhD candidate Felicity Williams. Dr Hibbert will be joining us as a Postdoctoral Fellow in February 2016.

During 2015 we achieved twelve publications, including four in Nature and Nature Communications. Several sampling and exchange visits were undertaken, among which were trips to Kochi (Japan), Bremen (Germany), Southampton (UK), and NIOZ and Utrecht (The Netherlands). We presented posters and talks at the major EGU (Vienna, Austria) and AGU (San Francisco, USA) geoscience conferences, as well as various smaller meetings and workshops that ranged in scope from studies of sea-level to climate-archaeology interactions. Also, we were well represented in both the lecturing and the student attendance at the Urbino Summer School of Paleoclimatology (Italy).

In addition, a new long-term collaboration was followed up through an exchange visit with ETH, Zurich (Switzerland).

Finally, we have installed and started to operate an AVAATECH XRF core-scanner.

Drs Gianluca Marino and Katharine Grant operating the core-scanner.



PALEO & ENVIRONMENTAL MAGNETISM (Group leader: David Heslop)

New Research Projects

Prof. Andrew Roberts was awarded funding for the 3 year ARC Discovery Project: Unmixing First-Order Reversal Curve (FORC) diagrams for quantitative environmental analysis.

International Visitors & Collaborators

Assoc. Prof. Greig Paterson, Chinese Academy of Sciences, investigating sediment grain size unmixing.

Prof. Qingsong Liu, Chinese Academy of Sciences, working on environmental magnetism of sediments.

Dr Zhaoxia Jiang, Chinese Academy of Sciences, working on the magnetic properties of hematite and goethite.

Dr Ping Liu, Chinese Academy of Sciences, working on microtektites in marine sediments.

Dr Adrian Muxworthy, Imperial College London, collaborating on the unmixing of First-Order Reversal Curve Diagrams.

Dr Richard Harrison, University of Cambridge, collaborating on the unmixing of First-Order Reversal Curve Diagrams.

New Group Members

Dr Pengxiang Hu, working on the ARC-funded project: How do sediments become magnetised? Construction of an empirical-numerical framework.

Dr Liang Chen, supported by the China Scholarship Council to work on the palaeomagnetism of marine sediments and quantifying the long-term morphology of Earth's magnetic field.

Invited Conference Presentations

A. P. Roberts, D. Heslop & L. Chang, How do sediments get magnetized? LatinMag 2015, São Paulo, Brazil.

A. P. Roberts, D. Heslop, L. Chang & T. Ouyang, Relative efficiencies of remanence acquisition in biogenic and detrital magnetite. American Geophysical Union Fall Meeting, 2015, San Francisco, USA.

Research Highlight

In recent years the Paleo & Environmental Magnetism workgroup has dedicated a lot of time to the measurement and interpretation of First-Order Reversal Curve (FORC) diagrams. High-resolution FORC diagrams are now being increasingly used in rock and environmental magnetism, including for detection of biomagnetic signals in sediments. Resolution can be a major barrier to obtaining high-quality FORC diagrams, and time-consuming measurements are necessary to resolve the finest features of a FORC distribution. This year we developed a new experimental protocol that allows different parts of a FORC diagram to be represented at different

resolutions through the use of an irregular measurement grid (Figure 1). The field steps used in the irregular measurement grid are determined through measurement of a major hysteresis loop, therefore our technique is completely objective. By employing an irregular grid, larger numbers of measurements can be made in key regions of a FORC distribution to resolve diagnostic features at higher resolution. This work has been published in the paper Zhao, X., D. Heslop, and A. P. Roberts (2015), A protocol for variable-resolution first-order reversal curve measurements, *Geochemistry, Geophysics, Geosystems*, 16, 1364–1377.

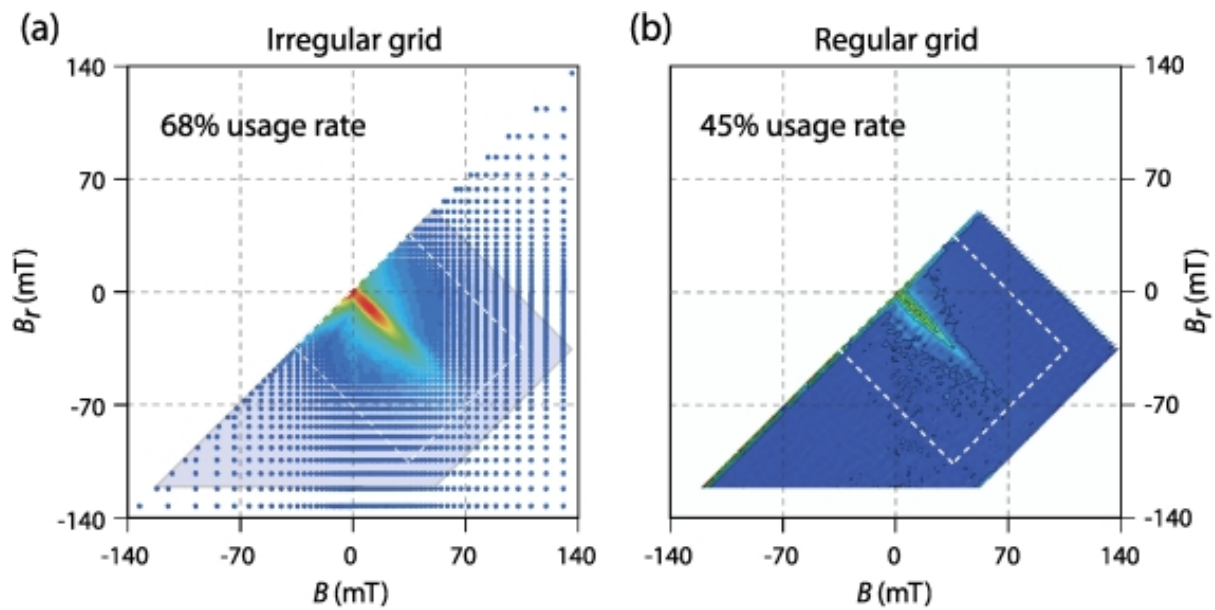


Figure 1. (a) FORC distribution measured using our new “irregular grid” protocol, which automatically takes more measurements in the regions of a FORC distribution that contain diagnostic features. (b) The traditional “regular grid” protocol employs equally spaced measurements, meaning fewer data points are in the diagnostic regions of the distribution (e.g. a lower usage rate).

PALAEOBIOGEOCHEMISTRY (Group leader: Jochen Brocks)

Staff and alumni

2015 was a year of major staff changes in the Palaeobiogeochemistry Group. PhD student Nur Gueneli handed in her thesis on the ecology and biomarkers of the Mesoproterozoic Taoudeni Basin, and PhD student Benjamin Bruisten will complete his thesis on climate cycles and microbial ecology of a Palaeoproterozoic sea by the end of the year – both are already back in their home country. Moreover, Eva Sirantoine has successfully completed her Masters thesis on biomarkers from the Western Officer Basin.

In February 2015 we were joined by new PhD candidate Ilya Bobrovskiy. Ilya won Russia's Geology Olympiads and completed a Masters in Geology at Russia's elite research institute Lomonosov Moscow State University. He will work on biomarkers and ancient Ediacaran environments of the White Sea area and was already helicoptered to a remote Russian location to collect samples (Figure 2). Ilya and Jochen also conducted field work in the southern Ural Mountains in July 2015.

MSc student Tharika Liyanage began an exciting project on biomarkers from a period leading into the great Snowball Earth glaciations and we had two PhD students, Lucy Wenger and Cameron Inglis, working on Proterozoic biomarkers. They both made major discoveries!

We were also able to attract eminent geologist Prof. Neil Williams as an official visitor to our laboratory. Neil is a pioneer of research on the HYC McArthur Zn/Pb deposit. He did his PhD on the deposit at Yale and went on to become the Chief Geologist of Exploration at MIM Holdings, the company that discovered and developed the deposit. He was the CEO of Geoscience Australia for 15 years, and is now an Honorary Professorial Fellow at the University of Wollongong. As an active collaborator on our new ARC DP project, he will perform SHRIMP sulfur isotope measurements on HYC samples.

Research Highlights

2015 again saw some major discoveries by students of the group. PhD student Lucy Wenger discovered an oil seep in Neoproterozoic rocks, and based on biomarker fingerprinting was able to determine that the oil is of very great antiquity, probably mid-Mesoproterozoic or even Palaeoproterozoic, and must have migrated from the underlying basement. PhD student Cameron Inglis performed chemical degradation experiments on 800 million years old kerogens and discovered what are probably the oldest functionalized biomolecules ever discovered on Earth. While writing up his thesis, Benjamin Bruisten did not stop making the most amazing biomarker discoveries, almost every week. He discovered an entire new suite of lipid biomarkers that probably have to be attributed to primordial organisms now long extinct. These findings may revolutionize our knowledge of early microbial evolution. Ilya, although just beginning his PhD, made a major discovery during his field work that will lead to a reinterpretation of the environment inhabited by the Ediacaran biota – he already has a manuscript in preparation.

Another highlight of the group is the win of an ARC Discovery Grant that was funded at an amazing 80% level. All the money of this grant will flow into our laboratory, so we will be able to do big and exciting research on early life and environments in the next three years.



Figure 1. Jochen and Masters student Anja from Lomonosov University discuss Neoproterozoic pre-Snowball sediments in the southern Ural Mountains.



Figure 2. PhD student Ilya Bobrovskiy collects fossils of the Ediacaran biota at cliffs of the White Sea in Russia. Only a one hour flight by helicopter gets you to this site.

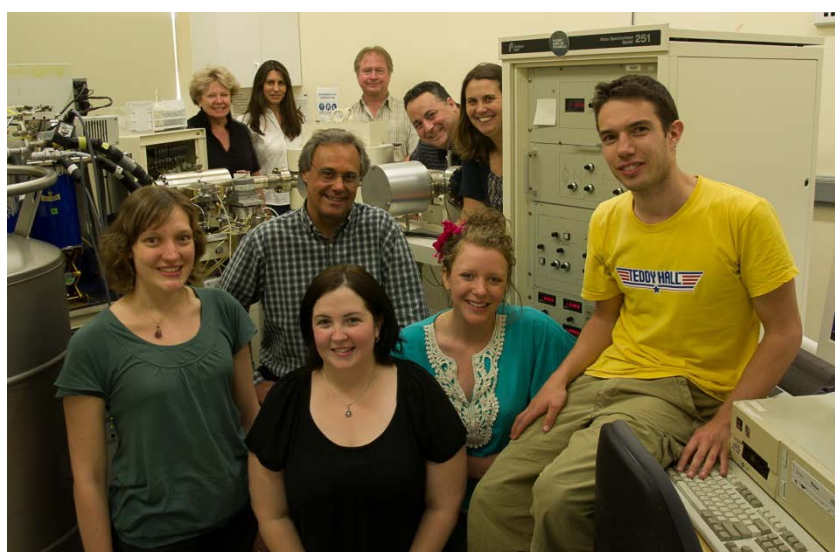
PAST CLIMATES & ENVIRONMENTAL IMPACTS (Group leader: Mike Gagan)

Overview

2015 was another exciting and productive year for the Past Climates & Environmental Impacts group. Our research aims to answer fundamental questions about past climate change and environmental impacts, particularly in the Southern Hemisphere and tropical Australasia. Group members are prominent in the use of geochemical tracers in corals, cave formations, and ice cores to reconstruct temperature, precipitation and vegetation dynamics, and natural hazards such as volcanic eruptions and great earthquakes. While our over-arching goal is to produce new knowledge about Earth's environment, our findings provide the scientific basis required for successful adaption to society's most challenging environmental threats, including anthropogenic climate change.

Members

The group comprises Mike Gagan, Nerilie Abram (ARC QEII Fellow), Bradley Opdyke, their students, and contributions from numerous colleagues. Dr Gagan's long-term research program in Indonesia with Prof. Wahyoe Hantoro and Dr Danny Natawidjaja (Indonesian Institute of Sciences) currently provides world-class opportunities for a cohort of five PhD scholars. Nick Scroxton (now at the University of Massachusetts) was awarded his PhD on Late Pleistocene environmental impacts on Flores, where *Homo floresiensis* (the Hobbit) was discovered in 2003. Claire Krause submitted her dissertation on the history of the Australasian monsoon over the last 40,000 years, and has landed a position at Geoscience Australia to start in January 2016, after completing an ARC and NCI-supported postdoctoral project on the Southern Annular Mode with Dr Abram. ARC *Discovery* grant funding supports PhD candidates Ali Kimbrough (speleothems in Sulawesi) and Jennifer Wurtzel (speleothems in Sumatra), and we welcomed Bethany Ellis (ex. UNSW) who will work on Sunda Strait coral records of the Indian Ocean Dipole.



Group members in the Earth Environment Stable Isotope Laboratory. Front (L to R): Bronwyn Dixon, Mike Gagan, Claire Krause, Ali Kimbrough, Nick Scroxton. Back (L to R): Joan Cowley, Heather Scott-Gagan, Bob Burne, Joe Cali, Nerilie Abram. Photo: Joe Cali.

Bob Burne is pursuing an M.Phil. on organomineralisation in microbialites in the Yalgorup Lakes, Western Australia. Honours student Cornell Hanxomphou was awarded a First Class mark for his use of speleothems to characterise the different drivers of Tasmanian climate over the last two millennia. ANU Summer Scholars Ben Nistor (Otago) and Sebastian Wong (Newcastle) joined us late in 2015 for several weeks as research interns. Much of our success is due to the Group's outstanding Professional Officers, Joe Cali, Joan Cowley and Heather Scott-Gagan, whose dedication and technical capabilities in the Earth Environment Stable Isotope Laboratory make it all possible.

We congratulate Nerilie Abram on earning a continuing appointment at RSES in April following completion of the School's academic renewal process.

Awards and Honours

The high standing of group members was recognized with awards and honours during the year. Dr Abram received the Australian Academy of Science 2015 Dorothy Hill Award for women in the earth sciences in recognition for advances in our understanding of Earth's climate system. Claire Krause was awarded the RSES Robert Hill Memorial Prize for outstanding research and communication in the earth sciences. Her commitment to effective communication included attendance at "Science Meets Parliament 2015" and a two-day internship at Parliament House at the invitation of the Honourable Adam Brandt (Greens MP).

Three of our PhD students presented talks at the 19th INQUA Congress (held in Nagoya, Japan) with financial support from an ANU Vice Chancellor Travel Award (Ali Kimbrough), an RSES DA Brown Travel Award (Jennifer Wurtzel) and AQUA Student Travel Prizes (Jennifer Wurtzel, Claire Krause). Dr Gagan was an invited speaker at the AGU Fall Meeting (held in San Francisco, USA).



Claire Krause (2nd from left) receives the Robert Hill Memorial Prize at her presentation of the Hill Memorial seminar on 25 November 2015. Also shown are fellow PhD students Ali Kimbrough (left) and Jennifer Wurtzel (2nd from right). Kelly Strzepek, the 2013 Robert Hill Memorial Prize winner, is on the right.

Research Highlights

The diversity and novelty of our research achievements in 2015 were well illustrated in several publications. A notable highlight was PhD scholar Claire Krause's role in an international team that examined the extent and expression of the Antarctic Cold Reversal in the Southern Hemisphere using a synthesis of 84 palaeoclimate records (published in *Nature Geoscience*). Dr Abram led a comprehensive assessment of location and length considerations for optimised coral reconstructions of the Indian Ocean Dipole (in *Paleoceanography*) with contributions by previous student researchers Bronwyn Dixon, Madi Rosevear and Ben Plunkett. She also co-authored a synthesis of tropical sea surface temperatures for the past four centuries by the PAGES Ocean2k consortium (also in *Paleoceanography*). Dr Gagan and colleagues described a novel palaeogeodetic method in *Earth and Planetary Science Letters* that utilises abrupt changes in coral $^{13}\text{C}/^{12}\text{C}$ records to detect coseismic seafloor displacement during megathrust earthquakes west of Sumatra. He also led the publication (in *Palaeo3*) of the serendipitous discovery of a cave-chamber hidden below Liang Bua on Flores with the potential to extend our knowledge of *Homo floresiensis*. Dr Opdyke co-authored a paper in *Nature Communications* showing links between the late deglacial warming history of Antarctica and the evolution of the Australian monsoon.

New Appointments and Service

Dr Gagan accepted a three-year appointment to the Scientific Advisory Board at the Earth Observatory of Singapore, Nanyang Technological University. Dr Abram took-up three new service roles in 2015: member of the Australian Academy of Science's National Committee for Earth System Science; co-chief editor for *Climate of the Past*; and joined the PAGES2k coordination team. Dr Opdyke was appointed to the position of RSES Honours Coordinator. Dr Burne served as Guest Professor in the Centre for Advanced Physics, University of Chongqing, and also as an Honorary Professor in the Department of Earth Sciences, University of Queensland where he is co-supervisor of Anderson Chagas, a PhD student on secondment from PETROBRAS working on microbialites of Lake Hawden, South Australia.

Laboratory Developments

Laboratory developments are underway along two fronts. Dr Abram is leading an ANU Major Equipment Committee bid for a portable Picarro high-precision water isotope analyser, and the group is formulating an ARC LIEF bid, led by ARC Laureate Fellow Eelco Rohling, to purchase mass spectrometer facilities dedicated to clumped isotope geochemistry.

PLANETARY SCIENCES (Group leader: Trevor Ireland)

The Planetary Sciences Institute (PSI) at ANU was formed to facilitate interactions between cosmochemists (at RSES) and astronomers at Mt Stromlo (RSAA). At RSES we have a number of researchers in cosmochemistry and chronology of the early solar system, as well as astrobiology, surface processes and spectroscopy. Our laboratories include mass spectrometers (SHRIMP, TIMS), as well as recently installed FTIR spectrometers and environmental chambers to simulate conditions beyond Earth.

Research highlights

A Planetary Crusts workshop was held to honour Emeritus Professor Ross Taylor in conjunction with the 90th birthday celebrations of Emeritus Professors Ross Taylor and Mervyn Patterson. Ross has been a stalwart of planetary science at ANU for many decades and he continues to write books that stimulate the discipline. We were joined by a number of Ross' colleagues including Larry and Jeff Taylor, as well as two of Ross' high flying students Scott McLennan and Roberta Rudnick. We can neither confirm nor deny stories concerning Ross' activities at JSC during Apollo 11 sample analysis. Ross' exploits were also featured in the ANU Reporter (<http://reporter.anu.edu.au/man-who-proved-moon-isn't-cheese>).

A highlight of this year for Australian planetary sciences is that we have been given official status as a NASA SSERVI (Solar System Exploration and Research Virtual Institute). SSERVI Australia is led out of Curtin University by ARC Laureate Professor Phil Bland, jointly with ANU.

A Planetary Science Workshop was held at ANU with about fifty planetary scientists from across Australia to discuss the state-of-the-art advances in planetary science, sponsored by the new SSERVI Australia group. A highlight of the meeting was a session on novel techniques being applied to planetary projects in Australia. Topics included new analytical techniques at the atom scale, physical and computational models of planets and exoplanets, atmospheric science on Venus or in the early earth, remote sensing, astrobiology, and the Desert Fireball Network for tracking meteorites. Tours of the RSES laboratories showcased ANU capabilities and the meeting concluded with discussions of new initiatives in planetary science in Australia and creative ways to enthuse the public and raise funds.

A new ANU meteorite catalogue was prepared by volunteer and alumnus Rick Hine. The catalogue includes detailed information on the samples and information on key references.

We congratulate Dr Adi Chopra and Dr Marian Sapah on the completion of their PhD studies and we wish them well for the future. Adi is famous around ANU for his 3-minute thesis prowess and helping out anyone and everyone during outreach activities.

Professor Hugh O'Neill, Laureate Fellow, was recognised as a Fellow of the American Geophysical Union.

PhD student Mr Christian Renggli won the 'Best Student Poster' Prize at the 2015 Australian Space Research Conference with his poster on "A thermochemical comparison of metal transport, speciation and condensation in a lunar volcanic gas and a terrestrial volcanic gas".

Honours student, Mrs Rachel Kirby, won the VSSEC-NASA Australian Space Prize for the best Geology and Planetary Geology Honours thesis in space sciences in Australia (2015).

Professor Trevor Ireland took up his position as Vice President of the Meteoritical Society, the organisation with the responsibility for cataloguing the world's inventory of meteorites.

Dr Raquel Salmeron, one of the original appointments to PSI, has left ANU to take up a position as a navigation engineer with Airservices Australia.



ROCK PHYSICS (Group leader: Stephen Cox)

The Group's research centres on high-pressure, high-temperature laboratory studies of (1) seismic properties of crustal and mantle lithosphere materials, and (2) deformation processes associated with fault slip in seismogenic and aseismic slip regimes, especially in the presence of reactive pore fluids.

Laboratory measurements of macroscopic physical properties such as seismic wave speeds and attenuation, strength, deformation rates and permeability are interpreted through microstructural studies using optical and electron microscopy. Often it is necessary to prepare, from either natural or synthetic precursors, simpler synthetic materials whose properties are amenable to more detailed interpretation than those of complex natural rocks. Our interest in Earth materials is shared by members of the School's Petrochemistry and Experimental Petrology Group, whose research focuses primarily upon the chemical aspects of their behaviour.

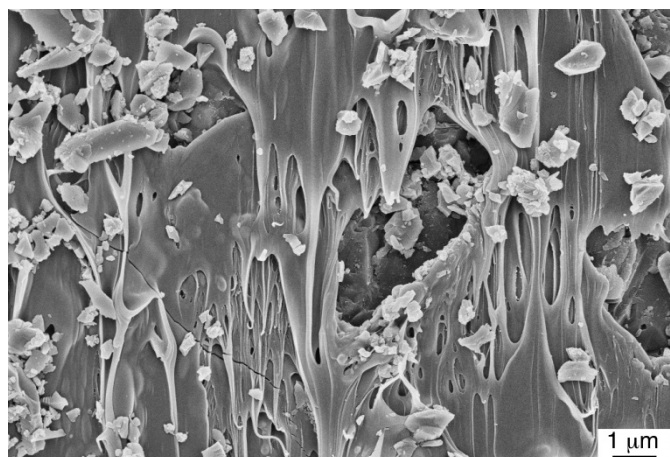
The experimental studies on fault mechanics are complemented by field-based studies, along with microstructural and isotopic studies and numerical modeling aimed at exploring coupling between deformation and fluid flow in exhumed faults, shear zones and hydrothermal ore deposits.

Our research has application to:

- geodynamics and seismology
- understanding controls on earthquake nucleation and rupture propagation
- understanding links between deformation, fluid flow and ore deposit formation.

A highlight this year was Kathryn Hayward's completion of her M.Phil. thesis which was an experimental study of fault slip processes on bare quartz interfaces. The study is the first demonstration of frictional melting of quartz during slip at seismogenic slip rates. A significant result was the demonstration that frictional melting can occur over slip distances of less than 100 μm at realistic crustal normal stresses. Kathryn received the "best student oral presentation award" at the recent conference of the Specialist Group in Tectonics and Structural Geology in Queensland.

Microstructure of quartz melt layer formed by fast (seismogenic) slip of 400 μm on a bare quartz interface at 40 MPa confining pressure and at room temperature. High resolution FE-SEM image. Image is dominated by glass filaments that have been stretched parallel to the fault slip direction during a slip event lasting only a few milliseconds. Fragments of broken glass and quartz gouge are also present.



SEISMOLOGY AND MATHEMATICAL GEOPHYSICS (Group leader: Malcolm Sambridge)

During 2015 the Seismology and Mathematical Geophysics group carried out research in structural and source seismology from the lithosphere to the core, Lithospheric and mantle dynamics and inverse theory, Natural Hazards, Geodynamics and community outreach through the Seismometers in Schools program.

This year saw the start of new AuScope programs to provide maintenance to the Earth imaging and seismometers in Schools programs. The ARC supported research projects within the group in the Discovery, Linkage and Future Fellow programs. Ongoing external funding support for various programs was also received from international sources including the US Dept. of Energy, DFAT/AuSAID, and The United Nations Comprehensive Test-Ban Treaty Organization.

The group's seismic instrument pool on both land and at sea has been deployed under the auspices of ANSIR, the national research facility for Earth sounding, in several field projects this year. These include the WASP (Western Australia Spiral Array) array shown as a blow up in Figure 1. An experimental style of configuration following the earlier SQsp array in Queensland. The array AQ3 in NSW/QLD was completed this year. AQ3 is a 50 kms spacing continuation of the rolling Wombat array used to explore the seismic structure of the Australian Continent. In WA the larger ALFEX (Albany-Fraser experiment) was deployed to image the edge of the WA craton in the Albany-Fraser Orogen. Figure 2 shows arrays deployed in Indonesia up to and including 2015 which have been used to study the amplification of seismic waves in basins in the context of natural hazard assessment. The new ANSIR community model, involving 11 institutions in Australia and New Zealand, has seen completion of activities in its first full year of operation.

Over the last 3 years the group has installed 44 research quality seismometers as part of a combined outreach and research program. Figure 3 shows the map of seismometer locations at the end of 2015. The seismometers send data back to the Research School of Earth Sciences, which is in turn sent in near real time to the Incorporated Research Institutions for Seismology (IRIS) data management center where it can be accessed by researchers around the world. The data is already being used for earthquake location (Geoscience Australia and the Geological Survey of South Australia) and for research within the school and within Australia. 2015 saw a much anticipated deployment in Alice Springs High School which improves the national coverage. Alongside the seismometers group members have also conducted workshops to assist teachers to incorporate seismology into the classroom. This year these include the National Youth Science Forum Teachers Summer School, the Australian Science Teachers Association annual conference and for Teacher Earth Science Education Programme (TESEP) professional development workshop. Social media has been used to maintain engagement with students, teachers and enthusiasts through our website <http://www.ausis.edu.au>, facebook page <https://www.facebook.com/ausisnetwork/> and youtube.

The Terrawulf computational facility, has seen significant hardware upgrades in 2015. All of the T2/T3 compute servers are operating and users are routinely running production code on the cluster. During the past year over 4 million CPU-hours have been consumed and almost 10 thousand jobs run on a wide range of earth science simulation and inversion problems. Average cluster utilisation was around 50% with frequent peaks of over 90%. 31 users have been active on the facility with 21 additional users through collaboration across 22 institutions in 8 countries. Group members also made extensive use of the National Computational Infrastructure facility and renewed its large time allocation grant on computational geophysics.

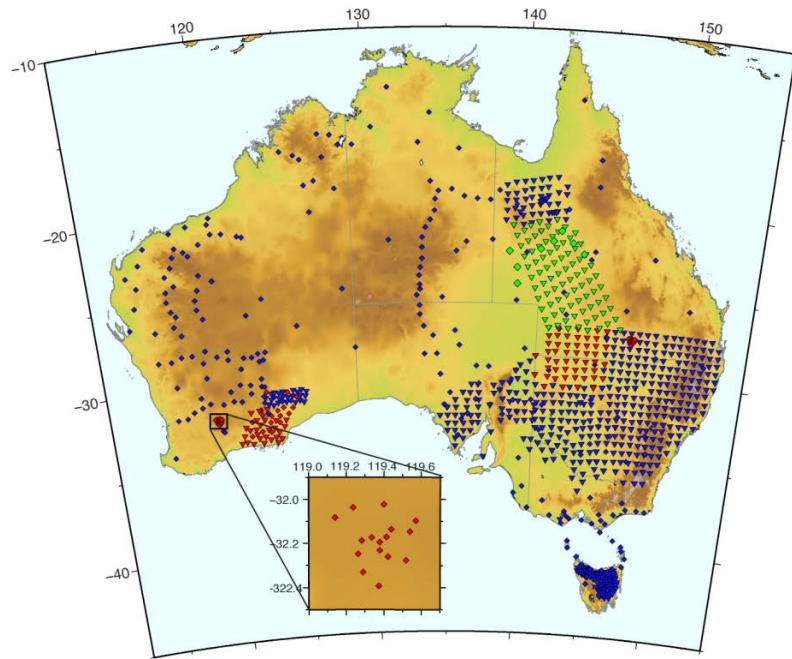


Figure 1. Locations of seismic field deployments of land based seismic instrumentation across all campaigns for 2015 (red) and pre 2015 (blue) and proposed for 2016 (green).

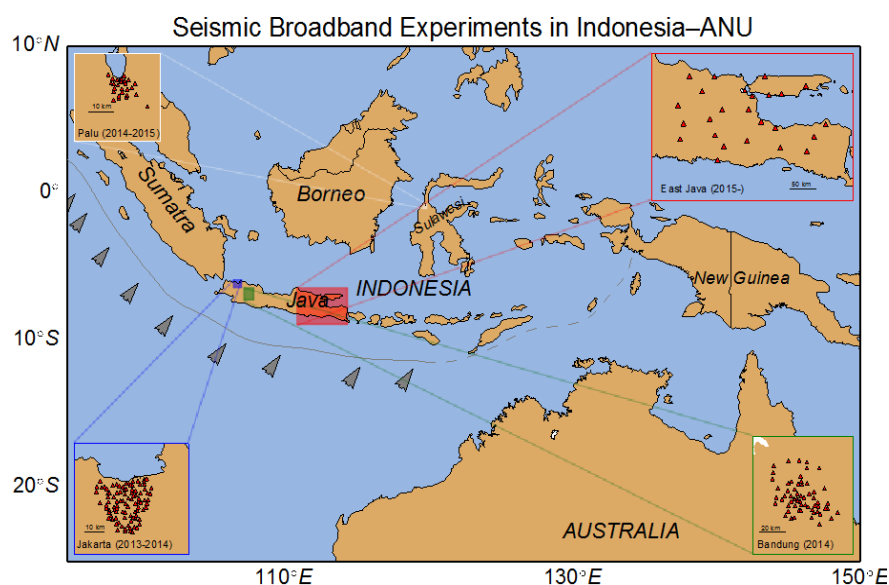


Figure 2. Locations of seismic field deployments in Indonesia up to and including 2015 in connection with Seismic Hazard research.

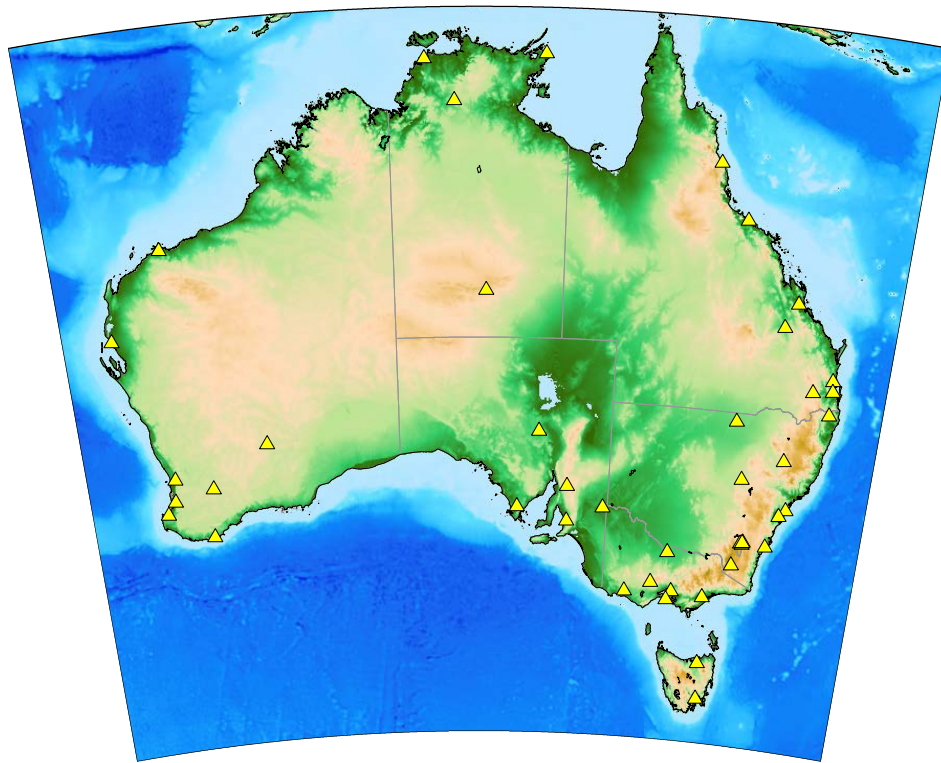


Figure 3. The Australian Seismometers in Schools array at the close of 2015. Locations of 44 deployments are shown as yellow triangles. This year a new instrument was installed in Alice Springs.

This year has seen work across a broad range of topics in seismology including the simultaneous exploitation of multiple seismic arrays and the nature of lithospheric heterogeneity. Methods using stacked station autocorrelograms to look directly at P wave reflectivity in the crust and uppermost mantle have been refined and applied to refining the structure of the Moho in southeastern Australia and an exploratory survey of structure in the mantle lithosphere and asthenosphere across the Australian continent. Recent collaborative work has also established the first Pn tomography across Australia and significantly improved definition of P wave structure in the upper mantle across the continent.

Other contributions in theoretical and global seismology were made toward the characterisation of complexities at the Earth's inner core and its boundary and new methods were developed for the measurement of Earth free oscillations using the Neighbourhood Algorithm. In other studies a new structural seismic model for northeast Asia was developed using ambient noise measurements as well as new methodologies for joint Surface wave dispersion and Receiver functions within a Bayesian framework. A project on real time earthquake monitoring has involved exploitation of the reciprocity theorem for efficient calculation of 3-D structural Green's functions in Australasia. This has the goal of rapid inversion for the realistic earthquake source parameters in complex earth models.

The group has also continued with the application and development of Bayesian inversion in global seismology, with several recent contributions, including the

characterisation of ultra-low velocity zones in the lowermost mantle; earthquake source parameter estimation; spherical harmonics expansion; and lithospheric structure.

In Natural Hazards the focus is on research into earthquakes and tsunamis as well as their impacts on society. In 2015 the group made important contributions to the science of earthquake source inversion, using both seismic and tsunami data, in particular showing how reverse imaging techniques commonly employed in seismology can be applied to tsunami data, and how better modeling of tsunami physics combined with new data inference techniques resolve important details of the source. The group has also progressed research on Indonesian earthquakes, with a seismic hazard studies of Sulawesi and Sumatra (See Figure 2), and an imaging study of the Jakarta basin that shows how remarkably deep and soft the infill sediments are, implying strong amplification of seismic waves in one of the world's most densely populated cities. During 2015 the group has worked with Indonesian collaborators on similar seismograph deployments in Palu and East Java that will be the focus of future work.

Trans-dimensional Bayesian inversion has been further developed in the context of 3-D imaging using the tree based algorithm reported on last year. Signal reconstruction of time dependent signals has become a focus in 2015. A new theory has been developed which extends earlier results in encompassing arbitrary noise contamination of observations in both the time and signal measurement. An application of the new technique has been the subject of a new collaboration with RSES staff in the Environmental area of the school in the reconstruction of relative sea level variations over the past 500 k.a.

In 2015, geodynamical research in the group focussed upon three key topics: (i) lowermost mantle dynamics and its seismic expression; (ii) the relationship between intra-plate volcanism and deep-mantle seismic structure; and (iii) the origin and expression of intra-plate volcanism on the Australian continent.

Together with international collaborators a study was carried out which reviewed a wide-range of seismological observations and their implications for deep mantle structure and dynamics. This study concluded that thermal heterogeneity alone can explain observed deep mantle seismic characteristics, which has important implications for Earth's thermo-chemical, geological and tectonic evolution.

The statistical significance was examined of the proposed correlation between volcanic hotspot locations and the reconstructed eruption sites of large igneous provinces at Earth's surface with deep mantle large low shear-wave velocity provinces (LLSVs). These rigorous tests demonstrate that the observed distribution of African and Pacific hotspots/reconstructed LIPs is consistent with the hypothesis that they are drawn from a sample that is uniformly distributed across the entire areal extent of each LLSVP. This result differs to the predictions of previous studies and has significant implications for our understanding of lowermost mantle dynamics and its surface expression.

In a separate collaborative study a result was obtained which identified the longest intra-plate continental hotspot track on Earth, a ~2000 km long track in eastern Australia that extends from central Queensland, through New South Wales and into Victoria. This work was published in *Nature* and received widespread media attention. A key conclusion is that lithospheric thickness variations have the dominant influence on volcanic outcrop and magma composition along this track, thus providing the first observational constraint on the sub-continental melting depth of mantle plumes.

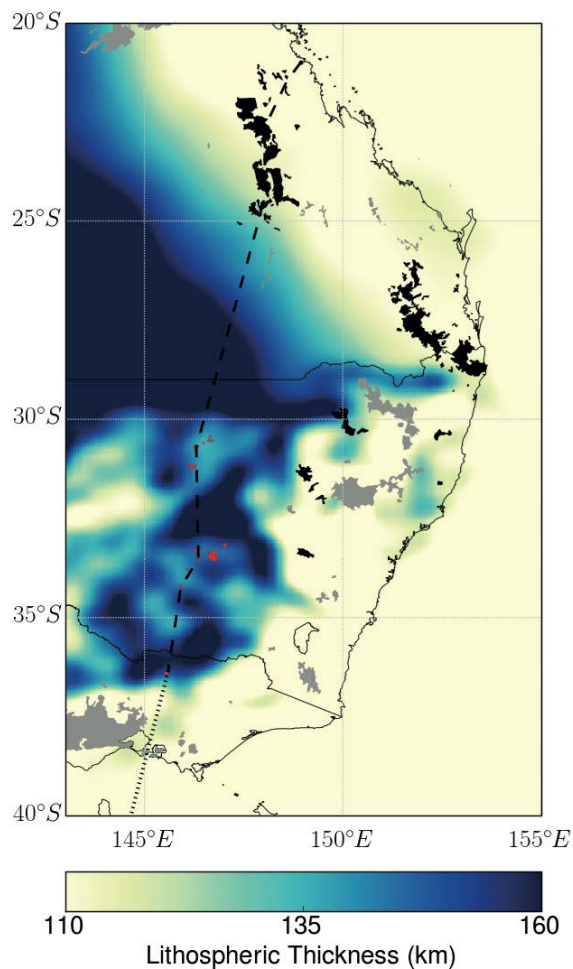


Figure 4. The distribution and classification of eastern Australian Cenozoic volcanic centers, where black, grey and red denote central-volcanos, basaltic lava-fields and low-volume, leucite-bearing volcanics, respectively. Earth's longest continental hotspot-track, the Cosgrove track, extends across the Australian continent from Cape Hillsborough (~33 Ma) to Cosgrove (~9 Ma), and incorporates both the central volcanos of central-Queensland and the leucite-suite of New South Wales and Victoria. These volcanic centres are plotted above an estimate of lithospheric thickness, highlighting a clear correlation between lithospheric thickness and volcanic outcrop, classification and composition along the Cosgrove hotspot-track (Davies et al. *Nature*, 2015).

Staff changes include the departures of Drs Josip Stipcevic and Giampiero Iaffaldano to positions in Europe. PhD. students Mr Surya Pachhai, Jakir Hoseen and Stephen Sagar submitted their theses during the year, while honours students Manon Dalaison began a project on geodynamics and Mr Jack Muir moved to Caltech to pursue a PhD in seismology and Mr Ingo Stoltz moved with Dr Iaffaldano to pursue his PhD studies. A newly arriving PhD student in the group was Mr Marcus Haynes. Mr Abhinav Purelli joined the staff as a Technical Officer at the Warramunga Seismic Array in the Northern Territory. Weijia Sun has been a longer term visitor this year from the Institute of Geology and Geophysics, Chinese Academy of Sciences.

STRUCTURE TECTONICS (Group leader: Gordon Lister)

This was a big year for the Structure Tectonics Team. Jiadong Shi completed his Honours degree, writing a thesis on “The northern extent of the Australian plate”, and is now employed in the teaching profession. Tomas O’Kane completed his PhD “4D Tectonic Reconstruction” and is on track for the award of his degree in early 2016. PhB student Fangqin Chen completed her special unit on the seismotectonics of Tibet. PhD candidate Fang Fang completed her mid-term. Two brand new Master of Earth Sciences (Advanced) candidates joined the group, Lin Shi and Fan Yin, and they have now completed the first six months of what will be an 18-month effort. In particular we congratulate Musri Mawaleda who sat his defence at Institut Teknologi Bandung in December 2015, with his co-supervisor, Dr Marnie Forster, in attendance.



The Master of Earth Sciences (Advanced) at RSES is a program aimed at bringing students adventure and training at the forefront of the discipline. The students spent one month camped in the Australian desert, southwest of Mount Isa, as part of an Advanced Structural Mapping special topic, supported by the Queensland Geological Survey (Sarah Sargent and Paul Donchak) and Chinova Resources (Mark McGeough).

The year ended with two of our PhD candidates in the final months of their candidature, writing up. Sarah Rajabi and Oleg Koudashev are on track for completing their theses during 2016. Sanjay Govindan and Ewout Rohling joined the group as Research Assistants.

It was a busy year also in terms of scientific visits. Professor Talat Ahmad interrupted his busy schedule as Vice-Chancellor of Jamia Millia University (JMI), Delhi, India to further our research together as part of our Australia India Strategic Research Fund (AISRF) project on the timing of events in the Himalayan orogeny. A paper is now in preparation as a result. His visit also set the scene in terms of organising interactions with ANU on other fronts, noting that JMI <http://jmi.ac.in/> is a major focus for Islamic studies. ANU's Centre for Arab and Islamic Studies <http://cais.anu.edu.au/> was also able to take advantage of his visit, and hosted a visit while he was with us. Other visitors included Dr Daniel Viète (Durham University) and Ms Adriana Rajkumar, a PhD candidate at The University of Sydney,

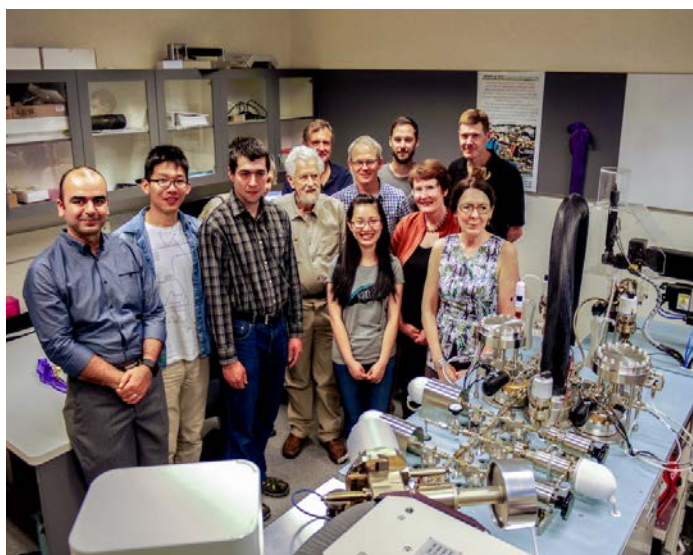
both of whom have collaborative projects in the argon lab, and Prof. Wiki Royden from MIT.

During the year members of the group also visited collaborating groups: Dr Marnie Forster visited Dr Fred Jourdan, at her partner argon facility, at John de Laeter, Curtin University. She also visited collaborating scientists, Prof. Alan Collins, Prof. John Foden and PhD students including Ms Fun Meeuws who has worked at ANU in her lab. Dr Jonathan Pownall visited Prof. Robert Hall at the South East Asia Research Group (SEARG) at Royal Holloway University of London, and Prof. Nick Rawlinson, University of Aberdeen, in connection with a Linkage Project in which these groups are involved, working with the Structure-Tectonics-Team at ANU.



Research conducted by the Structure Tectonics Team in 2015 largely focussed on the link between tectonics and mineralisation. On the very large scale the group continued its efforts in respect to 4D Tectonic Reconstruction. On the ground, a considerable geochronology program has been underway, with SHRIMP U–Pb analyses conducted by Dr Richard Armstrong, and $^{40}\text{Ar}/^{39}\text{Ar}$ analyses conducted by Dr Marnie Forster, shown (left) here with Mr Musri Mawaleda in the course of field work in Western Sulawesi. Our interactions with Institut Teknologi Bandung are of key importance to the group, and Musri has been a regular visitor to ANU.

A decade long effort on the part of Dr Marnie Forster came to fruition during 2015, with the formal opening of the new ANU argon facility, by Prof. Margaret Harding, Deputy Vice-Chancellor Research at ANU. The opening took place amid considerable pomp and ceremony, not the least of which was the first Poetry Competition ever held at RSES (won by Dr Antony Burnham).



The photo above shows (left to right): Davood Vasegh (Technical Officer), Lin Shi (Masters), Oleg Koudashev (PhD candidate), Prof. Ian McDougall (the father of Australian $^{40}\text{Ar}/^{39}\text{Ar}$ geochronology), Prof. Hugh O'Neill, Fang Fang (PhD candidate), Professor Steve Eggins (the end of the day of his inauguration as Director of RSES), Daniel Cummins (Electrical Workshop), Prof. Margaret Harding, Dr Marnie Forster (Manager RSES Argon Facility), and Andrew Wilson, Engineering Workshop Manager.

The ANUX summer school took place in late 2015, with three students from India, in the context of our AISRF project, and Mr Conrad Alderton and Ms Wulandari Mandradewi from G-resources in Sumatra, in the context of joint research in conjunction with our Australian Research Council funded Linkage Project.

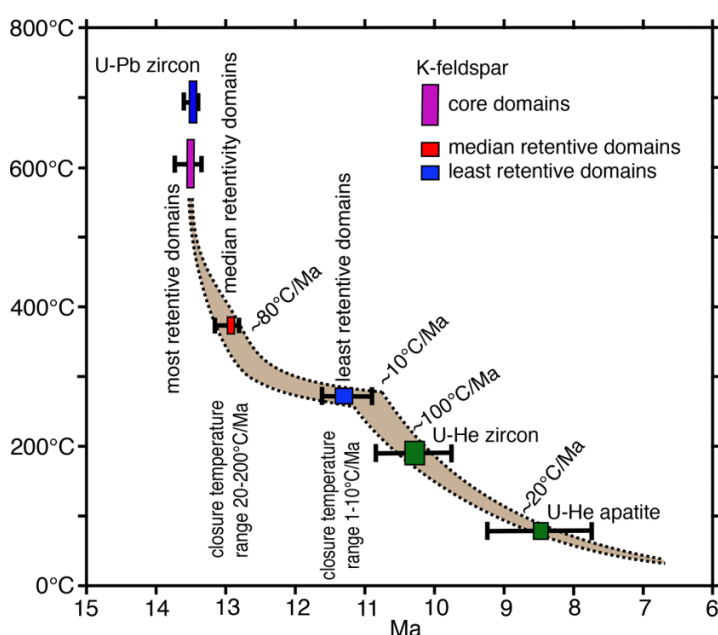
The ANUX The Summer School involved a massive effort by the group, with citations for their teaching efforts to Oleg Koudashev, Sareh Rajabi and Dr Marnie Forster for training in respect argon geochronology, mineral separation and microstructural analysis, Dr Richard Armstrong for training in the use of SHRIMP for U–Pb geochronology, Shane Paxton for his course of Lapidary and Mineral Separation, and Dr Frank Brink, Operations Manager for the Centre for Advanced Microscopy <http://microscopy.anu.edu.au> at ANU, for his intensive six week course on analytical and observational methods using the Hitachi Scanning Electron Microscope. The Indian students involved in the Summer School were visited by the First Consul from the Indian Embassy, The Honourable Mukesh Kumar, who inspected the students while they were busy with the Scanning Electron Microscope.

In other notable achievements for 2015, Jonathan Pownall won a Discovery Early Career Research Award to further investigate the tectonic drivers of extreme metamorphism in Eastern Indonesia. This will build on research carried out in 2015 into the study of ultra-high-temperature (UHT) metamorphism and mantle exhumation linked to slab rollback of the Banda Arc, in Indonesia. This work incorporated fieldwork, seismotectonic analysis, $^{40}\text{Ar}/^{39}\text{Ar}$ and U–Pb geochronology.

Research Highlights:

Retentive core domains in K-feldspar

Dr Marnie Forster and Dr Richard Armstrong demonstrated that SHRIMP U–Pb and $^{40}\text{Ar}/^{39}\text{Ar}$ ages coincide because K-feldspar in granite may contain retentive core domains that survive temperatures near to or above the granite solidus.



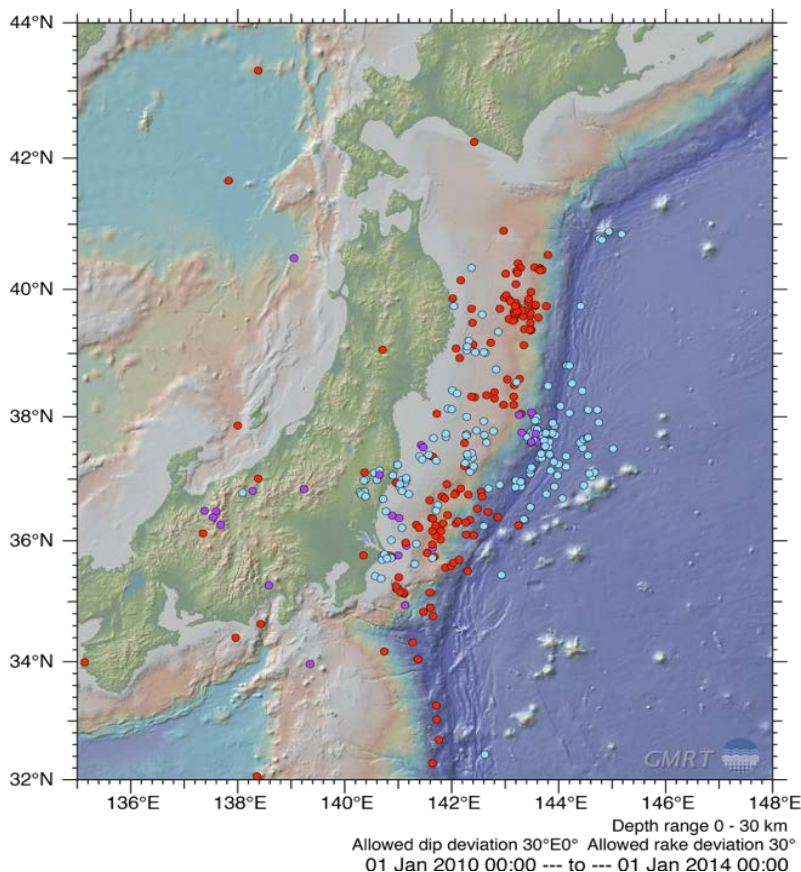
K-feldspar from the Miocene Capoas Granite on Palawan in The Philippines may contain core domains that closed to argon diffusion at temperatures near the solidus during cooling of this ~7km diameter pluton. This research involved collaboration with Dr Barry Kohn at The University of Melbourne, who provided the (U–Th)/He ages. This work was published in AJES, during 2015:

Doi: 10.1080/08120099.2015.1114524

This is an important result, for K-feldspar is supposedly not retentive in terms of its ability to retain argon. Closure temperatures for argon diffusion in K-feldspar are routinely claimed to be in the range $\sim 150\text{--}400^\circ\text{C}$. Yet the release of ^{39}Ar from irradiated K-feldspar during furnace step-heating experiments *in vacuo* yield Arrhenius data that imply highly retentive core domains, with inferred closure temperatures that exceed $\sim 500\text{--}700^\circ\text{C}$.

Controlling Lineaments for the 2011 Tohoku-Oki Great Earthquake

Earthquakes involve mechanical failure of large structures. Just as engineers do after a building or a dam collapses, forensic examination of the evidence identified critical elements that focussed the onset of failure, and which could therefore be monitored more closely in the interests of forecasting future events. The analysis showed that significant lineaments localized the onset of failure for events $>M_w=7$, both prior and subsequent to the 2011 Tohoku-Oki Great Earthquake.



The map shows hypocenters for earthquakes in the top 30 km of the crust, for the three years 2010–2013. Events are colour coded to show normal faults blue, thrusts and reverse faults red, and strike-slip faults purple. Image from the GMRT portal, overlain by data from the Global CMT project, produced by program *eQuakes*.

The data were analysed in the context of the “Satellites, Seismometers and Mass Spectrometers” initiative at RSES, involving cooperation and collaboration between three groups: the Geodesy and Seismology groups in the Geophysics cluster, and the Structure Tectonics Team, in Petrology, Geochemistry and Tectonics.

INTERNATIONAL OCEAN DISCOVERY PROGRAM

(Program Scientist: Neville Exon)

ANU'S role in IODP

IODP (www.iodp.org) is the world's largest and longest-lived geoscience research program, and it is at the frontier of global scientific challenges and opportunities, because ocean drilling is the best method of directly sampling the two-thirds of our world that is covered by oceans. IODP seeks to address global scientific problems by taking continuous core of rocks and sediments at a great variety of sites, from as deep as several kilometres below the sea bed. Its broad aim is to explore how the Earth has worked in the past, how it is working now, and how it may work in future. It uses a variety of platforms, and provides 'ground truthing' of scientific theories that are based largely on remote sensing techniques. IODP membership consists of 26 countries and it has an operational budget of \$US180 million p.a.

IODP's key research areas are:

- Climate and Ocean Change
- Biosphere frontiers
- Earth connections
- Earth in Motion

Australia and New Zealand are partners (iodp.org.au; <http://drill.gns.cri.nz>) in the ANZIC consortium within IODP, which involves both geoscientists and microbiologists, supported by an ARC/LIEF grant. Fifteen Australian universities and two government research agencies, and two New Zealand universities and two research agencies, were part of ANZIC in 2015. ANZIC scientists are making important contributions to IODP's scientific endeavours, and a number of major coring expeditions in our region and elsewhere have improved and will improve our understanding of global scientific questions. Membership of IODP helps us maintain our leadership in Southern Hemisphere marine research.

The Australasian region is vital to addressing various global science problems, and, accordingly, has seen a great deal of ocean drilling since 1968, when the first program was established. In 2015, eight Australians took part in IODP expeditions, including the University of Melbourne's Stephen Gallagher as Co-Chief Scientist on the *JOIDES Resolution* Indonesian Throughflow Expedition 356, examining the last 1.5 million years of oceanographic, climate and tectonic history on the northwest Australian margin. Mark Kendrick of ANU joined the *JOIDES Resolution* Southwest Indian Ridge Moho Expedition 360 in the western Indian Ocean as a petrologist. The *JOIDES Resolution* Western Pacific Warm Pool Expedition 363 will be in the Australian region in late 2016, and ANU's Brad Opdyke will be aboard as a sedimentologist. We expect more expeditions, mostly on *JOIDES Resolution*, in the Australia-New Zealand-Antarctica region in 2017 and 2018.

The *JOIDES Resolution* port calls in Fremantle and Darwin, related to Expedition 356, featured tours of the ship for about 150 selected people. All visitors were impressed by the unique capabilities of the ship, including the wonderful laboratory facilities. The

exhaustive core description and analysis production line can handle 6000 m of core on a single two-month expedition. Federal Assistant Minister for Science, Karen Andrews, visited the ship in Darwin, and was very interested in it and the IODP Program.



VIP Visit to *JOIDES Resolution* in Darwin on October 1st after successful IODP Expedition 356 off northwest Australia. Stephen Gallagher, Australian Co-chief Scientist; Brad Clement, Director, *JOIDES Resolution* Science Operator; Honourable Karen Andrews MP, Australian Assistant Minister for Science; Neville Exon, ANZIC Program Scientist.

ANZIC scientists gain in various ways from IODP: by being on international IODP panels, through shipboard and post-cruise participation in cutting edge science, by building partnerships with overseas scientists, by being research proponents and co-chief scientists who can steer programs and scientific emphasis, and by early access to key samples and data. Post-doctoral and doctoral students have an opportunity of training in areas of geoscience and microbiology that could not be obtained in any other way. Post-cruise ANZIC analytical funding is available for shipboard scientists, and a 2015 round of special funding for work on legacy ocean drilling material resulted in nine awards, six of \$A20,000 and three of \$10,000, including four to ANU-led scientific teams.

The Australian IODP Office at ANU is headed by ANZIC Program Scientist, Professor Neville Exon, and Professor Richard Arculus is the lead Chief Investigator on the ARC/LIEF LE140100047 grant. Ms Catherine Beasley is the Program Administrator.

The 2015 Australian IODP budget was \$A3 million of which \$US1.5 million went to the US National Science Foundation (NSF) as a membership fee.

In early 2015, the above group put a great deal of effort into a new ARC/LIEF bid, again with Richard Arculus as the lead Chief Investigator. This involved thirteen Australian universities and two government agencies, supported in ANZIC by two New Zealand universities and two government agencies. The end result was a clear mandate from the scientific community, and ARC/LIEF granted us \$2 million p.a. for five years (LE160100067), with an additional \$875,000 p.a. provided by our Australian members, and another \$US300,000 p.a. promised by our New Zealand colleagues. This stands us in very good stead as we look forward to a number of exciting expeditions in our region, in all of which ANZIC scientists will play leading roles.

In late 2015, ANU's Neville Exon and many others drafted an easily readable book reviewing ANZIC's role in the first phase of IODP, modelled on the similar legacy book "Full Fathom Five" covering Australia's role in the earlier Ocean Drilling Program. The new book is entitled "Exploring the Earth under the Sea: Australian and New Zealand achievements in the first phase of IODP Scientific Ocean Drilling, 2008-2013". It has largely been edited and should be published in the first quarter of 2016, both on paper and online.

RESEARCH SUPPORT

ELECTRONICS GROUP

Andrew Latimore, Tristan Redman, Norm Schram, Derek Corrigan, Daniel Cummins, David Cassar, Hideo Sasaki.

Introduction

The Electronics Group provides technical support to all Earth Sciences' academic research. The Group consists of one engineer, two senior technical offers and four technical officers. The Group holds the responsibility for maintaining and servicing electronic systems within RSES and offers a development facility able to engineer innovative electronic solutions. The Group provides a fast electronic circuit production facility utilising an automated component placement machine and reflow oven. The Electronics Group endeavours to ensure the Research School of Earth Sciences remains a state of the art institution.

Staffing and Labour

This year the Electronics Group bade farewell to two long term employees who retired during this period, Mr Norm Schram and Mr Derek Corrigan. Mr Schram, former manager of the Electronics Group, played a vital role in the development of the Sensitive High Resolution Ion Microprobe (SHRIMP) from its first idea to the fourth generation stable isotope focused apparatus. His contributions to the Research School of Earth Sciences' electronic engineering were exceptional, including several state of the art Electrometer developments that will give our Ion Microprobes a competitive research advantage. Mr Schram was greatly appreciated by his peers and colleagues. Mr Corrigan has also achieved a memorable career at RSES. Joining the Electronics Group for the last 10 years, he has brought valuable mechanical engineering skills into the Group. His vast knowledge of mechanical engineering and material science has allow him to develop endeavours including the cVar Vibrating reed Electrometer and ICPMS Rotating adjustable laser slit projects.

The 2015 Electronics Group's labour was heavily occupied by engineering design projects. The Group utilised 75.7% of resources on development tasks, 14.2% on school equipment maintenance and 10% on administrative tasks.

Engineering Developments

This period the Electronics Group worked steadily on development tasks. The main projects are summarised below.

cVar Vibrating Reed Electrometer

The cVar electrometer project evolved from previous electrometer designs (INSB and Iflex), because it offered the opportunity to realise an electrometer with input bias (background) currents of the order 2×10^{-17} A or lower. The design employs a sapphire insulated 'vibrating reed' input stage, incorporating a guarded coupling capacitor. Any of 3 resistive feedback elements can be selected, or charge can be integrated on the coupling capacitor. A 'shunt' function permits discharge of the capacitor. The reed assembly has been recovered from obsolete Cary 401 electrometers of ca 1960 vintage, as have some of the switching relays, however all have been relocated/remounted on new circuit boards and in an evacuated case. The evacuated case both removes most of the 'ionisation pulses' caused by incoming radiation, and maintains a dry and thermally stable environment for the high impedance components. Modern electronics perform all the necessary control, excitation and signal processing, together with flexible data acquisition, monitoring and control. All I/O (with the exception of power) is via fibre optics, to remove earth loops and data-traffic induced effects. Control and data acquisition are via the fibre-optic 'ION' network (a fibre optic media implementation of the ARCNET protocol).

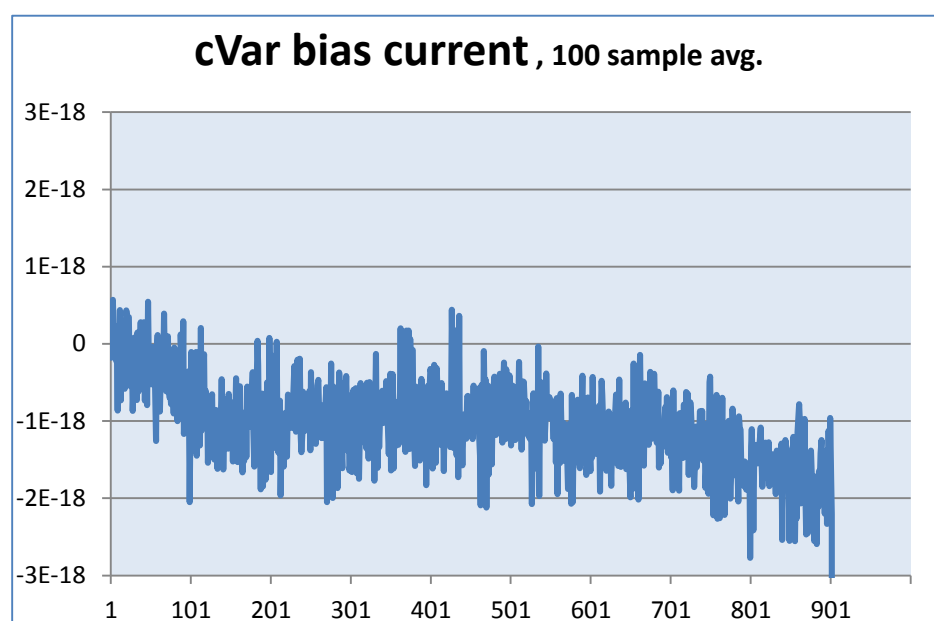


Figure 2. cVar background bias current measurements display long term stability down to 3.0×10^{-18} Ampere

Since the cVar was introduced to the SHRIMP SI acquisition system in October 2015, the results have immediately indicated improvements to the bias current levels previously observed. The long term stability bias currents recorded on the SHRIMP SI by the new cVar electrometers were observed as low as 2×10^{-18} Ampere.

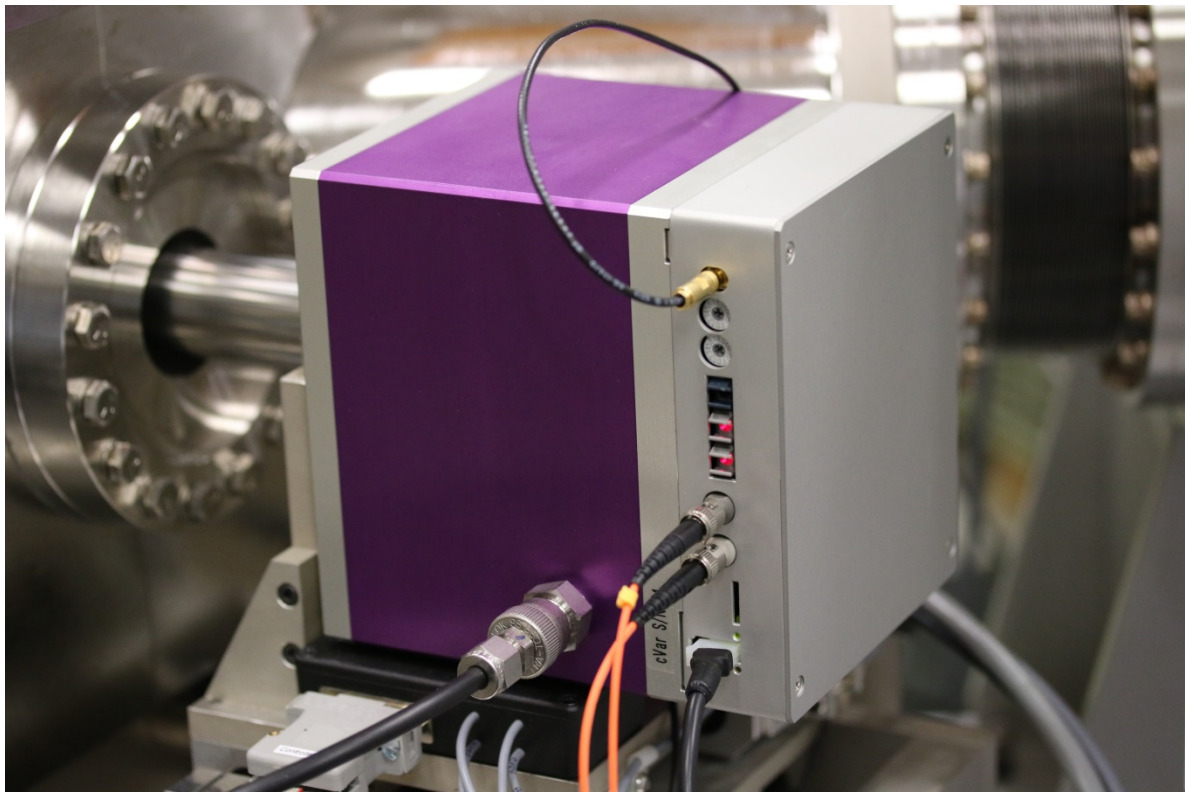


Figure 3. cVar installed on SHRIMP SI

Rotating Adjustable Laser Slit

The Rotating adjustable slit project evolved from previous motorised selectable slit mechanisms design by RSES Electronics. The new design will allow the user to control the laser spot size and shape by manipulating two variable slits that operate perpendicular to each other. Also the spot can be rotated 180 degrees giving the client complete control of the laser ablation site. The project involves three axes of micro stepper motor operation and a unique parallel drive mechanism to propel the slit edges with precision. The project is due for installation during 2016.

200T Gen II Piston Cylinder press automation

The GenII Press is a new 200T piston cylinder experimental apparatus designed and built by Geochemistry. Its mechanical design is a simplified version of existing 'twin press' configurations in use at RSES, packaged into a single press enclosure.

The GenII Press Automation project provides automated electric heating and pressure control, piston displacement monitoring, data logging and a graphical user interface. Users will be able to configure an experiment and have pressure and temperature profiles run automatically. Data will be displayed on charts during the experiment, and later saved to a file.

Digital Motor Controller

The Digital Motor Controller (DMC) project was developed by the RSES Electronics Group to enhance the capability to implement advanced electric motor systems. The project consists of a circuit board that is able to drive two motors simultaneously of different type and operation. The circuit can drive three main types of electric motor, Stepper motors DC servo and Brushless DC (BLDC) motors. The stepper motor type can be driven in both unipolar and bipolar, in full or half step modes. The DC motor can be driven in a closed servo loop operation using a position encoder or in direct open loop mode. Likewise the BLDC motor can be controlled in closed loop fashion using a position encoder or open loop direct drive operation.

The circuit communicates with the host computer using an ARCNET protocol network that is common to the RSES SHRIMP network and also provides galvanic isolation operating at floating high voltage installations.

This year the DMC project has been implemented to control direct current servo motors on SHRIMP 2 and SHRIMP RG. The circuit is also currently being designed into the control systems of the Rotating Adjustable Slit project.

One Atmosphere Furnace Interface

The One Atmosphere Furnace Interface (OAFI) enables users to control and monitor furnace temperatures and gas flows using a central touch screen panel PC. The system replaces an array of obsolete and fragmented hardware currently used to control Mass Flow Controllers (MFCs) with National Instruments data acquisition and control modules to provide a unified, maintainable and expandable interface for both furnace gas and temperature control.

The MFC capabilities are expanded to include control and read-back of up to 50 units, 10 per furnace. Simple charting enables a trend view of furnace parameters over time, such as gas flows and temperature. In addition, the project removes the need to program Eurotherm temperature controllers directly, an often cumbersome task. Users are able to set temperature program parameters and commence a program cycle using the touch screen.

The use of LabVIEW software allows a vibrant and intuitive user interface to be created allowing the furnaces to be operated easily with minimal operator training. LabVIEW also gives the flexibility to adapt the software to accommodate changing experimental techniques in the future.

MOKU ADC and DAC design and construction

The MOKU project is a multi-function high speed instrument that can generate and analyse signals providing the user with an oscilloscope, spectrum analyser and waveform generator conveniently viewed from an iPad. The RSES Electronics Group was contracted by Liquid Instruments to design and construct the printed circuit boards for their MOKU instruments. The Group also conducted testing and provides feedback to the company on various design directions. The project's electronics

engineering involves high speed amplifiers, analogue to digital conversion and digital to analogue conversion requiring skilled circuit board techniques to maintain signal integrity and minimise noise fluctuations. The Electronics Group produced and tested 200 operating units within the contracted deadline.

8 Channel Cold Seal Furnace

The 8 Channel Cold Seal Furnace project provides a new experimental facility capable of running 8 furnaces using a computer interface for automated control of sample heating. Data logging will enable viewing and storing of experiment parameters. The project involves programming of proportional, integral, differential (PID) controllers, accurately manipulating phase angle firing units to regulate furnace power. The system includes a computer interface and Labview user screen easily giving the client access to all system parameters and historical temperature trends. All electronics and software were developed by the RSES Electronics Group.

ENGINEERING WORKSHOP

Andrew Wilson, David Thomson (seconded to SHRIMP in July), Geoff Woodward, Carl Were, Brent Butler, Hayden Miller (1/2 time share with Rock Physics)

Workshop Highlights

Work continued on a new pressure intensifier for Rock Physics along with the group's usual sample preparation work. A higher than usual number of repairs and refurbishments of high pressure apparatus for Experimental Petrology took place, as well as the manufacture of some Hydrothermal High Pressure Apparatus.

The total number of jobs logged across the school increased by about 35% compared to 2014. This possibly indicates that the workshop was being utilised for smaller jobs and repairs to keep existing equipment going.

David Thomson took a 12 month secondment to the SHRIMP group starting in August.

5.1% of workshop time was spent on work external to RSES.

The move to 50% salary recovery occurred at the beginning of 2015. The internal recharge and other workshop earnings are used to fund 50% of workshop salaries.

Internal charge rate for 2015: \$45/hour + materials, consumables and running costs.

Core work undertaken during 2015:

Pressure Intensifier for Rock Physics, Prof. S Cox (G Woodward, H Miller, A Wilson)

SHRIMP Development and Maintenance, including CVar Electrometers, Prof. Trevor Ireland (H Miller, B Butler, G Woodward)

Vessel refurbishments, consumables and repairs, Prof. Hugh O'Neill (G Woodward, B Butler, C Were, A Wilson)

Hydrothermal Bombs, Dr J Mavrogenes (D Thomson, C Were, G Woodward, B Butler)

Argus 6 Support, Dr M Forster (C Were, D Thomson, B Butler, A Wilson)

Rotating Adjustable Slit for ICPMS, Prof. S Eggins (B Butler, D Thomson)

Clean Lab Cabinets, Dr M Ellwood (G Woodward)

Graphite line support, Dr S Fallon (C Were, H Miller, A Wilson)

| Table1 | | |
|--|--------------|----------|
| RSES Engineering Workshop Resource Distribution | | |
| Labour Totals | Hours | % |
| Uncharged Jobs | 1825 | 27.7 |
| Research Support | 4422 | 67.2 |
| External Work | 336 | 5.10 |
| Total | 6583 | |
| Uncharged Distribution | | |
| Staff Training | 394 | 21.6 |
| Administration | 653 | 35.8 |
| Workshop Equipment, Servicing and Repairs | 519 | 28.5 |
| Other | 258 | 14.1 |
| Total | 1824 | |

Note: Research group percentage split is unavailable as 4D database still uses old group designations.



Small parts for CVar Electrometers

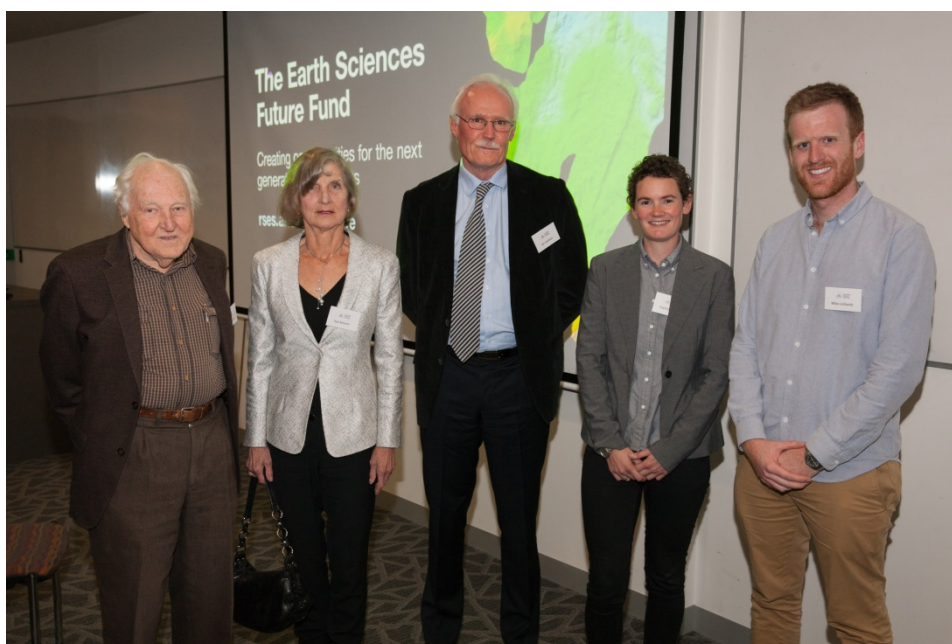
ALUMNI RELATIONS AND PHILANTHROPY

In 2015, Ian Jackson and Mary Anne King continued to work on delivering philanthropic income to support the School's pursuit of excellence in research and education. In May, the Earth Sciences Future Fund was launched by the Vice-Chancellor Professor Ian Young. This endowment will fund key priorities of scholarships, field education and geological collections. In the past eight months founding donors have generously contributed \$300,000. The Fund will create opportunities for the next generation of scientists.

Throughout the year there were many activities that alumni attended. Three special ones were:

- the 90th birthday celebrations for two of our most distinguished Emeritus Professors, Mervyn Paterson and Ross Taylor;
- ANU Alumni Awards Gala Dinner at the Australian National Gallery was a chance for RSES to say thank you to some of our inspirational and outstanding alumni;
- Bicentenary celebrations of the publication of the "Map of the Strata of England and Wales" by William Smith, an original copy of which hangs in the foyer of RSES. Professor Patrick De Deckker generously gave many lectures and workshops about our treasured "*Map that Changed the World*".

2015 saw many alumni continue to actively participate and enrich the life of the School.



Founding donors at the launch of the Earth Sciences Future Fund: Emeritus Professor Mervyn Paterson, Dr Sue Kesson, Professor Ian Jackson (then Director of RSES), Dr Sophie Lewis and Mr Michael Jollands. Photo credit: TBA

RESEARCH GRANTS AWARDED DURING 2015

Dr N.J. Abram, Prof. D. Phillips, Dr A.L. Jaques, Dr D.P. Araujo "Testing the drivers of Southern Annular Mode changes over the last millennium"; ANU merit allocation scheme for National Computational Infrastructure; 2015; 100 kSU (~\$10,000).

Dr G.B. Dunbar, Ms O. Albot, Dr P. Moss, **Dr N.J. Abram** "The origin of the Central Great Barrier Reef"; International Ocean Discovery Program (IODP) legacy funds (NZ); 2015; NZ\$14,820.

Prof. R.J. Arculus, A/Prof. D. Cohen, A/Prof. S. Gallagher, Prof. P. Vasconcelos, Prof. C. Elders, Prof. J. Foden, Prof. M. Coffin, A/Prof. O. Nebel, Dr H. McGregor Dr M. Clennell, Dr C. Sloss, Dr A. Heap, A/Prof. J. Webster, Dr A. Kemp, Prof. S. George "Australian membership of the International Ocean Discovery Program"; ARC Linkage Infrastructure, Equipment and Facilities (LIEF); 2016-2020; \$10,000,000.

A/Prof. D. O'Reilly, Dr L. Shewan, **A/Prof. R. Armstrong**, A/Prof. S. Lim, Dr N.J. Chang, Dr K. Domett, Dr S.E. Halcrow "Unraveling the mystery of the Plain of Jars, Laos"; ARC Discovery Project; 2015-2019; \$425,100.

A/Prof. R. Armstrong "A collaborative effort to advance in situ stable isotope analysis in the geosciences, environmental sciences and archaeometry"; Brazil Reference Group Collaboration Scheme, ANU; 2015-2016; \$5,000.

Prof. D. Weiss, **A/Prof. A.J. Berry**, Mr C. Lapinee "Characterisation of a new (patent-pending) material for the removal for arsenic from drinking water at point of usage"; Diamond Light Source; 2015; ~\$40,000.

A/Prof. A.J. Berry, **A/Prof. G.M. Yaxley**, Mr P.Y. Goodarzi "The oxidation state of Fe in mantle garnets and the oxygen fugacity of the lithospheric mantle"; Advanced Photon Source; 2015; ~\$40,000.

Dr A. Rosenthal, Prof. D. Frost, Dr S. Petitgirard, Dr V. Andrade, **A/Prof. A.J. Berry**, **A/Prof. G.M. Yaxley** "The fate and behaviour of volatiles during subduction of oceanic crustal material towards greater mantle depths"; European Synchrotron Radiation Facility; 2015; ~90,000.

Dr P.A. Brandl "Magmatic evolution during island arc inception (MEDIAN)"; Alexander von Humboldt Foundation (Return Fellowship); 2016; \$69,000.

A/Prof. J.J. Brocks, Prof. S. Poulton, Prof. N. Butterfield "Toppling the 'Boring Billion': Molecular fossils, orbital cycles and the dynamic nature of primordial life"; ARC Discovery Project; 2016-2018; \$412,200.

Prof. I.H. Campbell "Platinum group element geochemistry of the Galore Creek Au-Cu deposit"; Galore Creek Mining Co; 2016; C\$25,000.

Prof. I.H. Campbell "High precision geochronology and multi-sulfur isotope analyses of NeoArchean rocks and ore deposits in Yilgarn Craton, Western Australia"; Independence Group: Supplementary Scholarship; 2015-2016; \$7,080.

Prof. I.H. Campbell, **Prof. R.J. Arculus** "Are primitive MORBs sulphide saturated?"; ANZIC Special Analytical Funding; 2016-2017; \$20,000.

Dr M. Roach, **Prof. S. Cox**, **Dr P.L. King**, Dr S. McLaren, Dr C. Verdel, Dr A. George "Immersive visualization for field-based sciences"; Office of Learning and Teaching Innovation and Development Grant; 2015-2016; \$225,000 (\$11,000 to ANU).

Dr K. Grant, **Dr L. Rodriguez-Sanz**, **Prof. S. Eggins**, **Prof. E. Rohling** "Paleo-temperature reconstructions in the Mediterranean Sea across TII using planktic foraminifera"; ANZIC Special Analytical Funding; 2015; \$20,000.

Dr C. Frieman, **Prof. R. Grün**, Prof. M. Spriggs, **Dr R. Wood**, Dr M. Duval, Dr A. Valera "Beyond migration and diffusion: Exploring the movement of people, practices and technologies in the prehistoric world"; ARC Discovery Project; 2016-2019; \$502,246.

Prof. L. Botten, Prof. A. Pitman, Prof. D. Muller, Prof. M. Coote, Prof. D. Leinweber, Prof. A. Greentree, Prof. A. Mark, **A/Prof. A. Hogg**, Dr J. Zanotti, Prof. S. Smith, Prof. D. Bernhardt, Prof. S. Russo, Prof. J. Soria, Dr E. Izgorodina, Prof. L. Radom "Maintaining and enhancing merit-based access to the NCI National Facility"; ARC Linkage Infrastructure, Equipment and Facilities (LIEF); 2016-2018; \$3,000,000.

Dr P.L. King "Gas-Solid Reactions in Earth and Planetary Systems"; ARC Discovery Project; 2015-2018; \$287,500.

Dr P.L. King, Dr H. McGregor, **A/Prof. V. Bennett** "Developing a Strategy to Improve Career Pathways for Women at the Research School of Earth Sciences (RSES)"; ANU Gender Institute; 2015; \$9,000.

A/Prof. D.C. McPhail, **Dr P. King**, **Dr B. Opdyke**, Dr S. Beavis, Prof. W. Maher "Ion Chromatography for Chemical Analysis of Water, Soil and Rock"; ANU Major Equipment Committee (MEC); 2015; \$100,000.

Dr S.C. Lewis "What is extreme? Advancing insights into Australia's variable rainfall"; ARC Discovery Early Career Research Award (DECRA); 2016-2018; \$390,000.

Prof. S. Foley, **A/Prof. J. Mavrogenes**, Prof. A. Putnis, Prof. J. Brugger, Dr S. Clark, **Prof. H.StC. O'Neill**, Prof. A. Cruden, Dr K. Evans "Australian virtual experimental laboratory: a multimode geoscience facility"; ARC Linkage Infrastructure, Equipment and Facilities (LIEF); 2016; \$547,000.

A/Prof. J. Mavrogenes, **Dr P. King**, **Prof. R. Arculus**, **Dr M. Kendrick**, **A/Prof. G. Yaxley** "Laboratory for the study of high temperature magmatic volatiles"; ANU Major Equipment Committee (MEC); 2015; \$80,000.

A/Prof. S. McClusky, **A/Prof. P. Tregoning**, **Prof. S. Cox**, **Dr E. Papp**, **Prof. R. Grün** "High resolution remote sensing and surveying unmanned aerial vehicle"; ANU Major Equipment Committee (MEC); 2015; \$95,000.

Dr N. Stern, Dr Z. Jacobs, **A/Prof. S. McClusky**, **Prof. I. Williams**, Prof. C. Murray-Wallace, **Prof. R. Grün**, Dr T. Denham "Landscape archaeology at Lake Mungo"; ARC Discovery Project; 2015-2018; \$472,343.

Prof. A. Baker, Dr K. Meredith, Dr J.-P. Pigois, **A/Prof. M. Norman**, Dr V. Post, Ms H. Shortland-Jones "Unlocking the secrets of the groundwater cycle using Si and Li isotopes"; ARC Linkage Project; 2015-2016; \$138,000.

Prof. B.J. Pillans, A/Prof. D. McPhail, Prof. P.D. Hiscock, Dr A. Dosseto, **Dr E. Papp, Dr B.N. Opdyke**, Dr D.J. Clark, Mr J.D. Osborne, Mr H. Osborne, Mr W. Gregory "From ancient to modern environments in southeastern Australia: evidence from the unique natural archives of Lake George"; ARC Linkage Project; 2015-2018; \$450,000.

Prof. B. Pillans, Dr M. Forster, Dr B. Alloway "The correlation of Toba-sourced tephra from Indian Ocean and South China Sea marine cores to a hominin-bearing sequence in central Flores, eastern Indonesia"; ANZIC Special Analytical Funding; 2015; \$10,000.

Dr J.M. Pownall "Tectonic drivers of extreme metamorphism in Eastern Indonesia"; ARC Discovery Early Career Research Award (DECRA); 2016–2018; \$368,131.

Prof. A.P. Roberts, Dr R.J. Harrison, Dr A.R. Muxworthy "First-order reversal curve diagrams & quantitative environmental magnetism"; ARC Discovery Project; 2016-2018; \$210,000.

Prof. M.L. Roderick, A/Prof. P. Tregoning, A/Prof. A. Mc. Hogg "National Environmental Science Program, Earth Systems and Climate Change Hub"; Federal Department of Environment; 2016-2022; \$1,200,000.

Dr D. Kelsey, **Prof. D. Rubatto**, Prof. F. Spear "Impact of melt loss on crustal heat production and Earth geodynamics"; ARC Discovery Project; 2016-2018; \$160,000.

Prof. M. Sambridge, Dr N. Balfour, Dr M. Salmon "AuScope: Earth Imaging: Seismometers in Schools"; National Collaborative Research Infrastructure Strategy (NCRIS); 2015-2016; \$190,000.

Prof. M. Sambridge, Prof. B. Kennett, Dr M. Salmon "AuScope: Earth Imaging: Capital and Data operations"; National Collaborative Research Infrastructure Strategy (NCRIS); 2015-2016; \$1,190,000.

Prof. M. King, Dr A. Reading, **A/Prof. P. Tregoning, A/Prof. S. McClusky**, Dr C. Watson, Dr D. Eugene, Dr E. Pettit "A seismo-geodetic observation network for the Antarctic peninsular"; ARC Linkage Infrastructure, Equipment and Facilities (LIEF); 2015; \$190,000.

A/Prof. P. Tregoning, Dr A. Purcell "Sea level around Australia: Fingerprints of melting ice sheets"; ARC Discovery Project; 2016-2018; \$205,000.

Dr U. Troitzsch, Ms M.C. Nash, Dr B.N. Opdyke, Dr P.L. King "Crystal structure characterization of carbonates in coralline algae with micro-XRD"; Advanced Light Source, Lawrence Berkeley Laboratory; 2015-2016; In kind, beam time.

A/Prof. G.M. Yaxley, A/Prof. A.J. Berry, Prof. H.S. O'Neill, Dr R.P. Rapp, Dr S.D. Boger, Dr J.D. Woodhead, Prof. A.J. Gleadow, Dr L. Aye, Dr R.J. Sloggett, Dr D.L. Huston, Dr A.G. Tomkins, Dr A.P. Nutman, Dr J.A. Webb, Dr S.W. McKnight, Dr S.K. Florentine "A new national electron microprobe facility"; ARC Linkage Infrastructure, Equipment and Facilities (LIEF); 2015; \$970,000.

PUBLICATIONS

Abrajevitch A., Font E., Florindo F., **Roberts A.P.** (2015) Asteroid impact vs. Deccan eruptions: the origin of low magnetic susceptibility beds below the Cretaceous-Paleogene boundary revisited. *Earth and Planetary Science Letters*, 430, 209-223.

Abram N.J., **Dixon B.C.**, **Rosevear M.G.**, **Plunkett B.**, **Gagan M.K.**, Hantoro W.S., Phipps S.J. (2015) Optimised coral records of the Indian Ocean Dipole: an assessment of location and length considerations. *Paleoceanography*, doi: 10.1002/2015PA002810.

Aleinikoff J.N., Lund K., **Fanning C.M.** (2015) SHRIMP U-Pb and REE data pertaining to the origins of xenotime in Belt Supergroup rocks: Evidence for ages of deposition, hydrothermal alteration, and metamorphism. *Canadian Journal of Earth Sciences*, 52, 722-745, doi: 10.1139/cjes-2014-0239.

Andrade K., **Logemann J.**, Heidelberg K.B., Emerson J.B., Comolli L.R., Hug L.A., Keillor A., Thomas B.C., Miller C.S., Allen E.E., Moreau J., **Brocks J.J.**, Banfield J.F. (2015) Metagenomic and lipid analyses reveal a diel cycle in a hypersaline microbial ecosystem. *The ISME Journal* [Nature family journal of the International Society of Microbial Ecology], doi: 10.1038/ismej.2015.66.

Arculus R.J., Ishizuka O., Bogus K.A., Gurnis M., Hickey-Vargas R., Aljahdali M.H., Bandini A.N., Barth A.P., **Brandl P.A.**, Drab L., do Monte Guerra R., Hamada M., Jiang F., Kanayama K., Kender S., Kusano Y., Li H., Loudin L.C., Maffione M., Marsaglia K.M., McCarthy A., Meffre S., Morris A., Neuhaus M., Savov I.P., Sena C., Tepley III F.J., van der Land C., Yogodzinski G.M., Zhang Z. (2015) A record of spontaneous subduction initiation in the Izu-Bonin-Mariana arc. *Nature Geoscience*, 8, 728-733, doi: 10.1038/ngeo2515.

Arthaud M.H., Fuck R.A., Dantas E.L., Santos T.J.S., Caby R. **Armstrong R.** (2015) The Neoproterozoic Ceará Group, Ceará Central domain, NE Brazil: depositional age and provenance of detrital material. New insights from U-Pb and Sm-Nd geochronology. *Journal of South American Earth Sciences*, 58, 223-237.

Avigad D., Weissbrod T., Gerdes A., Zlatkin O., **Ireland T.R.**, Morag N. (2015) The detrital zircon U-Pb-Hf fingerprint of the northern Arabian-Nubian Shield as reflected by a Late Ediacaran arkosic wedge (Zenifim Formation; subsurface Israel). *Precambrian Research*, 266, 1-11.

Ayling B.F., **Chappell J.**, **Gagan M.K.**, McCulloch M.T. (2015) ENSO variability during MIS 11 (424-374 ka) from *Tridacna gigas* at Huon Peninsula, Papua New Guinea. *Earth and Planetary Science Letters*, 431, 236-246.

Balfour N.J., **Cummins P.R.**, **Pilia S.**, Love D. (2015) Localization of intraplate deformation through fluid-assisted faulting in the lower-crust: The Flinders Ranges, South Australia. *Tectonophysics*, 655, 97-106.

Bennett V. C., Nutman A.P. (2015) The Geochronology of the Isua Supracrustal Belt, southwest Greenland. In: Rink, W.J. & Thompson, J.W. (Eds.) *Encyclopedia of Scientific Dating Methods*. Springer, Netherlands 978 pp.

Berger J.A., **King P.L.**, Spilde M.N., Wright S.P., Kunkel T.S., Lee R.J. (2015) Effect of halite coatings on thermal infrared spectra. *Journal of Geophysical Research – Solid Earth*, 120, doi: 10.1002/2014.JB011712.

Blundy J., **Mavrogenes J.A.**, Tattich B., Sparks S., Gilmer A. (2015) Generation of porphyry copper deposits by gas-brine reaction in volcanic arcs. *Nature Geoscience*, 8, 235-240.

Bonamici C.E., **Fanning C.M.**, Kozdon R., Fournelle J.H., Valley J.W. (2015) Combined oxygen-isotope and U-Pb zoning studies of titanite: New criteria for age preservation. *Chemical Geology*, 398, 70-84, doi: 10.1016/j.chemgeo.2015.02.002.

Bosmans J.H.C., Drijfhout S.S., Tuenter E., Hilgen F.J., Lourens L.J., **Rohling E.J.** (2015) Precession and obliquity forcing of the freshwater budget over the Mediterranean. *Quaternary Science Reviews*, 123, 16–30.

Boyd P.W., Strzepek R.F., **Ellwood M.J.**, Hutchins D.A., Nodder S.D., Twining B.S., Wilhelm S.W. (2015) Why are biotic iron pools uniform across high- and low-iron pelagic ecosystems? *Global Biogeochemical Cycles*, 2014GB005014.

Brandl P.A., Genske F.S., Beier C., Haase K.M., Sprung P., Krumm S.H. (2015) Magmatic evidence for carbonate metasomatism in the lithospheric mantle underneath the Ohře (Eger) Rift. *Journal of Petrology*, 56, 1743-1774, doi: 10.1093/petrology/egv052.

Brandl P.A., Regelous M., Beier C., **O'Neill H.St.C.**, **Nebel O.**, Haase K.M. (2015) The timescales of magma evolution at mid-ocean ridges. *Lithos*, 240-243, 49-68, doi: 10.1016/j.lithos.2015.10.020.

Bristow T., Bish D., Vaniman D., Morris R., Blake D., Grotzinger J., Rampe E., Crisp J., Achilles C., Ming D., Ehlmann B., **King P.L.**, Bridges J., Eigenbrode J., Sumner D., Chipera S., Moorokian J.M., Treiman A., Morrison S., Downs R., Farmer J., Des Marais D., Sarrazin P., Floyd M., Mischna M., McAdam A. (2015) The origin and implications of clay minerals from Yellowknife Bay, Gale crater, Mars. *American Mineralogist*, 100, 824-36, doi: 10.2138/am-2015-5077CCBYNCND.

Brocks J. J., **Jarrett A.**, **Sirantoine E.**, Kenig F., Moczyłowska M., Porter S., **Hope J.** (2015) Early sponges and toxic protists: possible sources of cryostane, an age diagnostic biomarker antedating Sturtian Snowball Earth. *Geobiology*, doi: 10.1111/gbi.12165.

Broecker W.S., **Yu J.**, Putnam A.E. (2015) Two contributors to the glacial CO₂ decline. *Earth and Planetary Science Letters*, 429, 191-196.

Burnham A.D., Berry A.J., Halse H.R., Schofield P.F., Cibin G., Mosselmans J.F.W. (2015) The oxidation state of europium in silicate melts as a function of oxygen fugacity, composition and temperature. *Chemical Geology*, 411, 248-259.

Burnham A.D., Thomson A.R., Bulanova G.P., Kohn S.C., Smith C.B., Walter M.J. (2015). Stable isotope evidence for crustal recycling as recorded by superdeep diamonds. *Earth and Planetary Science Letters*, 432, 374-380.

Calo A., Prasetyo, B. Bellowood, P. Lankton J.W., Gratuze B., Pryce T.O., Reinecke A., Leusch V., Schenk H., **Wood R.**, Bawono R.A., Gede I., Ni LK Yulianti, Fenner J., Reepmeyer C., Castillo C., Carter A.K. (2015) Sembiran and Pacung on the north coast of Bali: a strategic crossroads for early trans-Asiatic exchange. *Antiquity*, 344, 378-396.

Camacho A., **Armstrong R.**, Davis D., Bekker A. (2015) Early history of the Amadeus Basin: Implications for the existence and geometry of the Central Superbasin. *Precambrian Research*, 259, 232-242.

Carilli J.E., McGregor H.V., Gaudry J.J., Donner S.D., **Gagan M.K.**, Stevenson S., Wong H., Fink D. (2015). Reply to comment by Karnauskas et al. on Equatorial Pacific coral geochemical records show recent weakening of the Walker Circulation. *Paleoceanography*, 30, 575-582, doi: 10.1002/2015PA002783.

Carilli J., Williams B., Schöne B.R., Krause R.A., **Fallon S.J.** (2015) Historical contaminant records from sclerochronological archives. In Blais J.M. et al (Eds.) *Environmental Contaminants, Developments in Paleoenvironmental Research*, 18, 355–91, Springer, doi: 10.1007/978-94-017-9541-8_13.

Castillo P., Fanning C.M., Hervé F., Lacassie J.P. (2015) Characterisation and tracing of Permian magmatism in the south-western segment of the Gondwanan margin; U-Pb age, Lu-Hf and O isotopic compositions of detrital zircons from metasedimentary complexes of northern Antarctic Peninsula and western Patagonia. *Gondwana Research*, doi: 10.1016/j.gr.2015.07.014.

Chang L., Heslop D., Roberts A.P., Rey D., Mohamed K.J. (2015) Discrimination of biogenic and detrital magnetite through a double Verwey transition temperature. *Journal of Geophysical Research*, doi: 10.1002/2015JB012485.

Chapman C.C., Hogg A.McC., Kiss A.E., Rintoul S.R. (2015) The dynamics of Southern Ocean storm tracks, *Journal of Physical Oceanography*, 45, 884–903, doi: 10.1175/JPO-D-14-0075.1.

Chen K.-H., Tseng Y.-L., Furumura T., **Kennett B.L.N.** (2015) Anisotropy in the subducting slab: observations from Philippine Sea plate events in Taiwan. *Geophysical Research Letters*, doi: 10.1002/2015GL066227.

Chen M., Campbell I.H., Xue Y., Tian W., Ireland T.R., Holden P., Cas R.A.F., Hayman P.C., Das R. (2015) Multiple sulfur isotope analyses support a magmatic model for the volcanogenic massive sulfide deposits of the Teutonic Bore volcanic

complex, Yilgarn craton, Western Australia. *Economic Geology*, 110, 1411-1423.

Chopping R., Kennett B.L.N. (2015) The depth to magnetisation in Australia and its uncertainty, *GeoResJ*, 7, 70-77, doi: 10.1016/j.grj.2015.06.003.

Clemens S.C., Kuhnt W., LeVay L.J., and the Expedition 353 Scientists, including **Marino G.** (2015) Indian monsoon rainfall. International Ocean Discovery Program Preliminary Report, 353, doi: 10.14379/iodp.pr.353.2015.

Cooper A.F., **Ireland T.R.** (2015) The Pounamu terrane, a new Cretaceous exotic terrane within the Alpine Schist, New Zealand; tectonically emplaced, deformed and metamorphosed during collision of the LIP Hikurangi Plateau with Zealandia. *Gondwana Research*, 27, 1255-1269

Cracknell M.J., Reading A.M., **De Caritat P.** (2015) Multiple influences on regolith characteristics from continental-scale geophysical and mineralogical remote sensing data using Self-Organising Maps. *Remote Sensing of Environment*, 165, 86-99, doi: 10.1016/j.rse.2015.04.029.

Danielopol D.L., Baltanás A., Carbonel P., Colin J.-P., Crasquin S., Decrouy L., **De Deckker P.**, Gliozzi E., Groos-Uffenorde H., Horne D.J., Iepure S., Keyser D., Kornicker L.S., Lord A., Martens K., Matzke-Karasz R., Miller C.G., Oertli H.J., Pugliese N., Russo A., Sames B., Schön I., Siveter D.J., Smith A. (2015) From Naples 1963 to Rome 2013-A brief review of how the International Research Group on Ostracoda (IRGO) developed as a social communication system. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 419, 3-22.

Davies D.R., Goes S., Lau H.C.P. (2015) Thermally dominated deep mantle LLSVPs: a review. In: Khan A., Deschamps F., Kawai K. (Eds.) *The Earth's heterogeneous mantle*, 441-478, Springer, doi: 10.1007/978-3-319-15627-9_14.

Davies D. R., Goes S., **Sambridge M.** (2015) On the relationship between volcanic hotspot locations, the reconstructed eruption sites of LIPs and deep mantle seismic structure. *Earth and Planetary Science Letters*, 411, 121-131, doi: 10.1016/j.epsl.2014.11.052.

Davies D. R., Rawlinson N., **Iaffaldano G.**, **Campbell I. H.** (2015) Lithospheric controls on magma composition along Earth's longest continental hotspot track. *Nature*, 525, 511–514, doi: 10.1038/nature14903.

De Caritat P., Cooper M. (2015) A continental-scale geochemical atlas for resource exploration and environmental management: the National Geochemical Survey of Australia. *Geochemistry: Exploration, Environment, Analysis*, doi: 10.1144/geochem2014-322.

De Deckker P. (2015) Trace-elemental distribution in ostracod valves. From solution ICPMS and laser ablation ICPMS to microprobe mapping: a tribute to Rick Forester. *Hydrobiologia*, doi: 10.1007/s10750-015-2534-4.

Dettmer J., Dosso S.E., Bodin T., **Stipčević J.**, **Cummins P.R.** (2015) Direct-seismogram inversion for receiver-side structure with uncertain source-time functions. *Geophysical Journal International*, 203, 1373-1387, doi: 10.1093/gji/ggv375.

Dittus A.J., Karoly D.J., Alexander L.V., **Lewis S.C.** (2015) A multi-region assessment of observed changes in the areal extent of temperature and precipitation extremes. *Journal of Climate*, doi: <http://dx.doi.org/10.1175/JCLI-D-14-00753.1>.

Dosso S. E., **Dettmer J.**, Wilmot M. J. (2015) Efficient localization and spectral estimation of an unknown number of ocean acoustic sources using a graphics processing unit. *The Journal of the Acoustical Society of America*, 138, 2945–2956, doi: 10.1121/1.4934517.

Ellwood M.J., Hutchins D.A., Lohan M.C., Milne A., Nasemann P., Nodder S.D., Sander S.G., **Strzepek R.**, Wilhelm S.W., Boyd P.W. (2015) Iron stable isotopes track pelagic iron cycling during a subtropical phytoplankton bloom. *Proceedings of the National Academy of Sciences*, 112, E15-E20.

Ellwood M.J., Schneider L., Potts J., Batley G.E., Floyd J., Maher W.A. (2015) Volatile selenium fluxes from selenium-contaminated sediments in an Australian coastal lake. *Environmental Chemistry*, doi: 10.1071/EN14228.

Ewing T.A., **Rubatto D.**, Beltrando M., **Hermann J.** (2015) Constraints on the thermal evolution of the Adriatic margin during Jurassic continental break-up: U-Pb dating of rutile from the Ivrea-Verbano Zone, Italy. *Contributions to Mineralogy and Petrology*, 169, 44. Doi: 10.1007/s00410-015-1135-6.

Fallon S., McDougall A., Espinoza T., Roberts D.T., Brooks S., Kind P. (2015) Updated methods to age the Australian lungfish: Reply to Kemp (2015). *Radiocarbon*, 57: 195–96, doi: 10.2458/azu_rc.57.18199.

Fano M.A., Cubas M., **Wood R.** (2015) The first farmers in Cantabrian Spain: Contribution of numerical chronology to understand an historical process. *Quaternary International*, 364, 153-161.

Faul U., **Jackson I.** (2015) Transient creep and strain energy dissipation. *Annual Review of Earth and Planetary Sciences*, 43, 541-569.

Fenner J.N., Clark G., Cressey A., Valentin F., Olesen S.H., **Armstrong R.** (2015). Isotopic uniformity and segregation in Tongan mounds. *Journal of Archaeological Science: Reports*, 2, 644-653.

Ferreira V.P., Sial A.N., Pimentel M.M., **Armstrong R.**, Guimarães I.P., da Silva Filho A.F., de Lima M.M.C., da Silva T.R. (2015) Reworked old crust-derived shoshonitic magma: the Guarany pluton, northeastern Brazil. *Lithos*, 232, 150-161.

Florindo F., Gennari R., Persico D., Turco E., Villa G., Lurcock P.C., **Roberts A.P.**, Winkler A., Carter L., Pekar S.F. (2015) New magnetobiostratigraphic chronology

and paleoceanographic changes across the Oligocene-Miocene boundary at DSDP Site 516 (Rio Grande Rise, SW Atlantic Ocean). *Paleoceanography*, 30, 659-681.

Fontaine F.R., Barruol G., **Tkalčić H.**, Wölbern I., Rumpker G., Bodin T., Haugmard M. (2015) Crustal and uppermost mantle structure variation beneath La Réunion hotspot track. *Geophysical Journal International*, 203, 107-126.

Forster M.A., **Armstrong R.**, Kohn B., **Lister G.S.**, Cottam M.A., Suggate S. (2015) Highly retentive core domains in K₂feldspar and their implications for ⁴⁰Ar/³⁹Ar thermochronology illustrated by determining the cooling curve for the Capoas Granite, Palawan, The Philippines. *Australian Journal of Earth Sciences*, doi: 10.1080/08120099.2015.1114524.

French K.L., Hallmann C., **Hope J.M.**, Schoon P.L., Zumberge J.A., Hoshino Y., Peters C.A., George S.C., Love G.D., **Brocks J.J.**, Buick R., Summons R.E. (2015) Archean hydrocarbon biomarkers: syngenetic or not? *Proceedings of the National Academy of Sciences*, 112, 5915-5920.

Friedrich O., Norris R.D., Wilson P.A., **Opdyke B.N.** (2015) Newfoundland Neogene sediment drifts: transition from the Paleogene greenhouse to the modern icehouse. *Scientific Drilling*, 19, 39-42.

Fu B., Bröcker M., **Ireland T.**, **Holden P.**, **Kinsley L.P.J.** (2015) Zircon U–Pb, O, and Hf isotopic constraints on Mesozoic magmatism in the Cyclades, Aegean Sea, Greece. *International Journal of Earth Sciences*, 104, 75-87.

Gagan M.K., **Ayliffe L.K.**, Smith G.K., Hellstrom J.C., **Scott-Gagan H.**, Drysdale R.N., Anderson N., Suwargadi B.W., Aplin K.P., Zhao J.-x., Groves C.W., Hantoro W.S., Djubiantono T. (2015) Geoarchaeological finds below Liang Bua (Flores, Indonesia): A split-level cave system for *Homo floresiensis*? *Palaeogeography, Palaeoclimatology, Palaeoecology*, 440, 533-550.

Gagan M.K., **Sosdian S.M.**, **Scott-Gagan H.**, Sieh K., Hantoro W.S., Natawidjaja D.H., Briggs R.W., Suwargadi B.W., Rifai H. (2015) Coral ¹³C/¹²C records of vertical seafloor displacement during megathrust earthquakes west of Sumatra. *Earth and Planetary Science Letters*, 432, 461-471.

Gal M., Reading A.M., Ellingsen S.P., Gualtieri L., Koper K.D., Burlacu R., **Tkalčić H.**, Hemer M.A. (2015) The frequency dependence and locations of short-period microseisms generated in the Southern Ocean and West Pacific. *Journal of Geophysical Research*, 120, doi: 10.1002/2015JB012210.

Gayen B., **Griffiths R.W.**, **Kerr R.C.** (2015) Melting driven convection at the ice-seawater interface. *Procedia IUTAM (International Union of Theoretical and Applied Mechanics)*, 15, 78-85, doi: 10.1016/j.piutam.2015.04.012.

Gehrmann R.A.S., **Dettmer J.**, Schwalenberg K., Engels M., Dosso S.E., Özmaral A. (2015) Trans-dimensional Bayesian inversion of controlled source electromagnetic

data in the German North Sea. *Geophysical Prospecting*, 63, 1314–1333, doi: 10.1111/1365-2478.12308.

Gernon T.M., Spence S., Trueman C.N., Taylor R.N., **Rohling E.J.**, Hatter S.J., Harding I.C. (2015) Emplacement of the Cabezo Maria lamproite volcano (Miocene, SE Spain). *Bulletin of Volcanology*, 77, 52, doi: 10.1007/s00445-015-0934-y.

Gibson G.M., Champion D.C., **Ireland T.R.** (2015) Preservation of a fragmented late Neoproterozoic–earliest Cambrian hyper-extended continental-margin sequence in the Australian Delamerian Orogen. Geological Society, London, Special Publications, 413, SP413.8.

Gibson G.M., Meixner A.J., Withnal I.W., Korsch R.J., Hutton L.J., Jones L.E.A., Holzchuh J., Costelloe R.D., Henson P.A., **Saygin E.** (2015) Basin architecture and evolution in the Mount Isa mineral province, northern Australia: Constraints from deep seismic reflection profiling and implications for ore genesis. *Ore Geology Reviews*, doi:10.1016/j.oregeorev.2015.07.013.

Gibson G.M., Roure F., Manatschal G. (Eds.) (2015) *Sedimentary Basins and Crustal Processes at Continental Margins: From Modern Hyper-extended Margins to Deformed Ancient Analogues*. Geological Society, London, Special Publications, 413, 340pp.

Gibson G.M., Roure F., Manatschal G. (2015) Sedimentary Basins and Crustal Processes at Continental Margins: From Modern Hyper-extended Margins to Deformed Ancient Analogues: an introduction. In: **Gibson G. M.**, Roure F., Manatschal G. (Eds.) *Sedimentary Basins and Crustal Processes at Continental Margins: From Modern Hyper-extended Margins to Deformed Ancient Analogues*. Geological Society, London, Special Publications, 413, 1-8.

Gillespie R., **Wood R.**, **Fallon S.**, Stafford Jr. T.W., Southon J. (2015) New 14C dates for Spring Creek and Mowbray Swamp megafauna: XAD-2 processing. *Archaeology in Oceania*, 50, 43-48.

Giuliani A., Phillips D., Woodhead J.D., Kamenetsky V.S., Fiorentini M.L., Maas R., Soltys A., **Armstrong R.A.** (2015) Did diamond-bearing orangeites originate from MARID-veined peridotites in the lithospheric mantle? *Nature Communications* 6, doi: 10.1038/ncomms7837.

Glibin V.P., **King P.L.** (2015) Prediction of the thermodynamic functions of mixing of binary oxide melts in the PbO–SiO₂, Al₂O₃–SiO₂ and CaO–Al₂O₃ systems by structure-based modification of the quasi-chemical model. *Calphad*, 49, 19-34, doi: 10.1016/j.calphad.2015.02.001.

Gouramanis C., **De Deckker P.**, Wilkins D., Dodson J.R. (2015) High-resolution, multiproxy palaeoenvironmental changes recorded from Two Mile Lake, southern Western Australia: implications for Ramsar-listed playa sites. *Marine and Freshwater Research*, doi: 10.1071/MF14193.

Grammer G.L., **Fallon S.J.**, Izzo C., **Wood R.**, Gillanders B.M. (2015) Investigating bomb radiocarbon transport in the southern Pacific Ocean with otolith radiocarbon. *Earth and Planetary Science Letters*, 424, 59–68, doi: 10.1016/j.epsl.2015.05.008.

Gregory D., Large R., Halpin J., Steadman J., Hickman A., **Ireland T.**, **Holden P.** (2015) The chemical conditions of the late Archean Hamersley Basin inferred from whole rock and pyrite geochemistry with $\Delta^{33}\text{S}$ and $\delta^{34}\text{S}$ isotope analyses. *Geochimica et Cosmochimica Acta*, 149, 223-250.

Griffi, J., Latief H., Kongko W., Harig S., Horspool N., Hanung R., Rojali A., Maher N., Fuchs A., Hossen J., Upi S., Dewanto S.E., Rakowsky N., **Cummins P.R.** (2015) An evaluation of onshore digital elevation models for modeling tsunami inundation zones. *Frontiers in Earth Science*, 3, 32, doi: 10.3389/feart.2015.00032.

Griffiths R.W., **Gayen B.** (2015): Turbulent convection insights from small-scale thermal forcing with zero net heat flux at a horizontal boundary. *Physical Review Letters*, 115, 204301.

Griffiths R.W., **Kerr R.C.** (2015) Coupling of cooling, solidification and gravity-driven flow. IUTAM Symposium on Multiphase flows with phase change: challenges and opportunities, Hyderabad, India, 8-11 December 2014. *Procedia IUTAM* 15, 165-171.

Grimm R., Maier-Reimer E., Mikolajewicz U., Schmiedl G., Muller-Navarra K., Adloff F., **Grant K.M.**, Ziegler M., Lourens L.J., Emeis K.-C. (2015) Late glacial initiation of Holocene eastern Mediterranean sapropel formation. *Nature Communications*, 6, 7099, doi: 10.1038/ncomms8099.

Hanger B.J., **Yaxley G.M.**, **Berry A.J.**, Kamenetsky V.S. (2015) Relationships between oxygen fugacity and metasomatism in the Kaapvaal subcratonic mantle, represented by garnet peridotite xenoliths in the Wesselton kimberlite, South Africa. *Lithos*, 212-215, 443-452.

Hawkins R., **Sambridge M.**, (2015) Geophysical imaging using trans-dimensional trees. *Geophysical Journal International*, 203, 972-1000, doi: 10.1093/gji/ggv326.

Hayman P.C., Hull S.E., Cas R.A.F., Summerhayes E., **Amelin Y.**, Ivanic T.J., Price D. (2015) A new period of volcanogenic massive sulfide formation in the Yilgarn: a volcanological study of the ca 2.76 Ga Hollandaire VMS deposit, Yilgarn Craton, Western Australia. *Australian Journal of Earth Sciences*, 62, 189-210.

Hayman P.C., Thébaud N., Pawley M.J., Barnes S.J., Cas R.A.F., **Amelin Y.**, Sapkota J., Squire R.J., **Campbell I.H.**, Pegg I. (2015) Evolution of a ~2.7 Ga large igneous province: A volcanological, geochemical and geochronological study of the Agnew Greenstone Belt, and new regional correlations for the Kalgoorlie Terrane (Yilgarn Craton, Western Australia). *Precambrian Research*, 270, 334-368.

Henley R.W., King P.L., Wykes J.L., Renggli C.J., Brink F.J., Clark D.A., Troitzsch U. (2015) Formation of porphyry copper deposits through sustained SO₂ flux and chemisorption. *Nature Geoscience*, 8, 210-15, doi: 10.1038/ngeo2367.

Hennig J., Hall R., **Armstrong R.A.** (2015) U-Pb zircon geochronology of rocks from west Central Sulawesi, Indonesia: extension-related metamorphism and magmatism during the early stages of mountain building. *Gondwana Research*, doi: 10.1016/j.gr.2014.12.012.

Heslop D. (2015) Numerical strategies for magnetic mineral unmixing. *Earth-Science Reviews*, 150, 256-284.

Hogg A.McC., Meredith M. P., Chambers D.P., Abrahamsen E.P., Hughes C.W. Morrison A.K. (2015) Recent trends in the Southern Ocean eddy field, *Journal of Geophysical Research*, 119, doi: 10.1002/2014JC010470.

Honda M., Zhang X., Phillips D., Hamilton D., Deerberg M., Schwieters J.B. (2015) Redetermination of the ²¹Ne relative abundance of the atmosphere, using a high resolution, multi-collector noble gas mass spectrometer (HELIX-MC Plus). *International Journal of Mass Spectrometry*, 387, 1-7.

Hossen J., Cummins P. Roberts S., **Allgeyer S.** (2015) Time reversal imaging of the tsunami source. *Pure and Applied Geophysics*, 172, 969-984, doi: 10.1007/s00024-014-1014-5.

Hossen M.J., Cummins P.R., Dettmer J., Baba T. (2015) Time Reverse Imaging for Far-field Tsunami Forecasting: 2011 Tohoku Earthquake Case Study. *Geophysical Research Letters*, doi: 10.1002/2015GL065868.

Hossen M.J., Cummins P.R., Dettmer J., Baba T. (2015) Tsunami waveform inversion for the 2011 Tohoku earthquake: Importance of dispersion and source kinematics. *Journal of Geophysical Research*, 120, 6452–6473, doi: 10.1002/2015JB011942.

Howard E., Hogg A.McC., Waterman S., Marshall D.P. (2015) The injection of zonal momentum by buoyancy forcing in a Southern Ocean model. *Journal of Physical Oceanography*, 45, 259-271, doi: 10.1175/JPO-D-14-0098.1.

Hu P., Liu Q.S., **Heslop D., Roberts A.P.**, Jin C. (2015) Soil moisture balance and magnetic enhancement in loess-paleosol sequences from the Tibetan Plateau and Chinese Loess Plateau. *Earth and Planetary Science Letters*, 409, 120-132.

Hua Q., Webb G.E., Zhao J., Nothdurft L.D., Lybolt M., Price G.J., **Opdyke B.N.** (2015) Large variations in the Holocene marine radiocarbon reservoir effect reflect ocean circulation and climatic changes. *Earth and Planetary Science Letters*, 422, 33-44.

Huston D.L., **Mernagh T.P.**, Hagemann S.G., Doublier M.P., Fiorentini M., Champion D.C., **Jaques A.L.**, Czarnota K., Cayley R., Skirrow R., Bastrakov E. (2015) Tectono-metallogenic systems - the place of mineral systems within tectonic evolution, with

an emphasis on Australian examples. *Ore Geology Reviews*, doi: 10.1016/j.oregeorev.2015.09.005.

Hutchinson D.K., England M.H., **Hogg A.McC.**, **Snow K.** (2015) Interhemispheric Asymmetry of Warming in an Eddy Permitting Coupled Sector Model. *Journal of Climate*, 28, 7385-7406, doi: 10.1175/JCLI-D-15-0014.1.

Iizuka T., Yamaguchi A., Haba M.K., **Amelin Y.**, **Holden P.**, **Zink S.**, **Huyskens M.H.**, **Ireland T.R.** (2015) Timing of global crustal metamorphism on Vesta as revealed by high-precision U–Pb dating and trace element chemistry of eucrite zircon. *Earth and Planetary Science Letters*, 409, 182–192.

Iizuka T., Yamaguchi T., Hibiya Y., **Amelin Y.** (2015) Meteorite zircon constraints on the bulk Lu–Hf isotope composition and early differentiation of the Earth. *Proceedings of the National Academy of Sciences (PNAS)*, 112, 5331–5336.

Iles K.A., Hergt J.M., Sircombe K.N., Woodhead J.D., Bordorkos S., **Williams I.S.** (2015) Portrait of a reference material: Zircon production in the Middledale Gabbroic Diorite, Australia, and its implications for the TEMORA standard. *Chemical Geology*, 402, 140–152.

Jackson I. (2015) Properties of Rocks and Minerals - Physical Origins of Anelasticity & Attenuation in Rock. In: Schubert G. (ed.) *Treatise on Geophysics*, 2nd edition, 2, 539-571.

Jackson M.J., Koga K.T., Price A., Konter J.G., Koppers A.A.P., Finlayson V.A., Konrad K., Hauri E.H., Kylander-Clark A., Kelley K.A., **Kendrick M.A.** (2015) Deeply dredged submarine HIMU glasses from the Tuvalu Islands, Polynesia: implications for volatile budgets of recycled oceanic crust. *Geochemistry Geophysics Geosystems* 16, 1-25, doi:10.1002/2015GC005966.

Jayananda M., Chardon D., Peucat J.-J., **Fanning C.M.** (2015) Paleo- to Mesoarchean TTG accretion and continental growth in the western Dharwar craton, Southern India: Constraints from SHRIMP U–Pb zircon geochronology, whole-rock geochemistry and Nd–Sr isotopes. *Precambrian Research*, 268, 295-322, doi: 10.1016/j.precamres.2015.07.015.

Jenner F.E., Hauri E.H., Bullock E.S., König S., **Arculus R.J.**, **Mavrogenes J.A.**, Mikkelsen N., Goddard C. (2015) The competing effects of sulfide saturation versus degassing on the behavior of chalcophile elements during the differentiation of hydrous melts. *Geochemistry, Geophysics, Geosystems*, 16, 1490-1507.

Jin Z.D., An Z., **Yu J.**, Li F., Zhang F. (2015) Lake Qinghai sediment geochemistry linked to hydroclimate variability since the last glacial. *Quaternary Science Reviews*, 122, 63-73.

Jin Z., West A.J., Zhang F., An Z., Hilton R.G., **Yu J.**, Wang J., Li G., Wang X. (2015) Seismically enhanced solute fluxes link silicate weathering with tectonic activity. *Geology*, doi: 10.1130/G37246.1.

Joannes-Boyau, R. Bodin, T., Scheffers, A., **Sambridge, M.**, (2015) Using Benford's law to investigate natural hazard dataset homogeneity, *Scientific Reports*, 5, 12046, doi: 10.1038/srep12046.

Joy Solen, Jelsma H., Tappe S., **Armstrong R.** (2015) SHRIMP U-Pb zircon provenance of the Sullavai Group of Pranhita-Godavari Basin and Bairenkonda Quartzite of Cuddapah Basin, with implications for the Southern Indian Proterozoic tectonic architecture. *Journal of Asian Earth Sciences*, 111, 827-839.

Kamenetsky V.S., **Park J-W.**, Mungall J.E., Pushkarev E.V., Ivanov A.V., Kamenetsky M., **Yaxley G.M.** (2015) Crystallisation of platinum-group minerals from silicate melts: evidence from Cr-spinel-hosted inclusions in volcanic rocks. *Geology*, 43, 903-906.

Kamenetsky V.S., **Yaxley G.M.** (2015) Carbonate-silicate liquid immiscibility in the mantle propels kimberlite magma ascent. *Geochimica et Cosmochimica Acta*, 158, 48-56.

Kemner F., Haase K.M., Beier C., Krumm S., **Brandl P.A.** (2015) Formation of andesite melts and Ca-rich plagioclase in the submarine Monowai Volcanic System, Kermadec Arc. *Geochemistry Geophysics Geosystems*, doi: 10.1002/2015GC005884.

Kendrick M.A., Honda M., Vanko D.A. (2015) Halogens and noble gases in Mathematician Ridge meta-gabbros, NE Pacific: Implications for oceanic hydrothermal root-zones and global volatile cycles. *Contributions to Mineralogy and Petrology* 170, 1-20.

Kendrick M.A., Jackson M.G., Hauri E.H., Phillips D. (2015) The halogen (F, Cl, Br, I) and H₂O systematics of Samoan Lavas: assimilated-seawater, EM2 and high ³He/⁴He components, *Earth and Planetary Science Letters* 410, 197-209.

Kennett B.L.N. (2015) Lithosphere–asthenosphere P-wave reflectivity across Australia, *Earth and Planetary Science Letters*, 431, 225–235, doi: 10.1016/j.epsl.2015.09.039.

Kennett B.L.N., Furumura T. (2015) Toward the reconciliation of seismological and petrological perspectives on oceanic lithosphere heterogeneity. *Geochemistry, Geophysics, Geosystems*, 16, 3129-3141, doi: 10.1002/2015GC006017.

Kennett B.L.N., Saygin E. (2015) The nature of the Moho in Australia from reflection profiling: a review, *GeoResJ*, 5, 74-91, doi: 10.1016/j.grj.2015.02.001.

Kennett B.L.N., Saygin E., Salmon M. (2015) Stacking autocorrelograms to map Moho depth with high spatial resolution in southeastern Australia, *Geophysical Research Letters*, 42, doi: 10.1002/2015GL065345.

Kennett B.L.N., Stipčević J., Gorbatov A., (2015) Spiral arm seismic arrays, *Bulletin of the Seismological Society of America*, 105, 2109-2116, doi: 10.1785/0120140354.

Kerr R.C., McConnochie C.D. (2015) Dissolution of a vertical solid surface by turbulent compositional convection. *Journal of Fluid Mechanics*, 765, 211-228.

Kim J.-H., Schouten S., Rodrigo-Gámiz M., Rampen S., **Marino G.**, Huguet C., Helmke P., Buscail R., Hopmans E.C., Pross J., Sangiorgi F., Middelburg J.J., Sinninghe Damsté J.S. (2015) Influence of deep-water derived isoprenoid tetraether lipids on the TEXH86 paleothermometer in the Mediterranean Sea. *Geochimica et Cosmochimica Acta*, 150, 125–141.

King A.D., Donat M.G., Fischer E.M., Hawkins E., Alexander L.V., Karoly D.J., Dittus A.J., **Lewis S.C.**, Perkins S.E. (2015) The timing of anthropogenic emergence in simulated climate extremes. *Environmental Research Letters*, 10, 094015.

King A.D., van Oldenborgh G.J., Karoly D.J., **Lewis S.C.** (2015) Attribution of the record high Central England temperature of 2014 to anthropogenic influences. *Environmental Research Letters*, 10, 054002.

Koulali A., Tregoning P., McClusky S., Stanaway R., Wallace L., **Lister G.** (2015) New insights into the present-day kinematics of the central and western Papua New Guinea from GPS. *Geophysical Journal International*, 202, 993-1004.

Kuchenbecker M., Pedrosa-Soares A.C., Babinski M., **Fanning M.** (2015) Detrital zircon age patterns and provenance assessment for pre-glacial to post-glacial successions of the Neoproterozoic Macaúbas Group, Araçuaí orogen, Brazil. *Precambrian Research* 266, 12-26, doi: 10.1016/j.precamres.2015.04.016.

Kuhnt W., Holbourn A., Xu J., **Opdyke B.**, **De Deckker P.**, Röhl U., Mudelsee M. (2015) Southern hemisphere control on Australian monsoon variability during the late deglaciation and Holocene. *Nature communications*, 6, 5916, doi: 10.1038/ncomms6916.

Kusbach V., Janoušek V., Hasalová P., Schulmann K., **Fanning C.M.**, Erban V., Ulrich S. (2015) Importance of crustal relamination in origin of the orogenic mantle peridotite–high-pressure granulite association: example from the Náměšť Granulite Massif (Bohemian Massif, Czech Republic). *Journal of the Geological Society*, 172, 479-490, doi: 10.1144/jgs2014-070.

Lane M.D., Bishop J.L., Dyar M.D., Hiroi T., Mertzman S.A., Bish D.L., **King P.L.**, Rogers A.D. (2015) Mid-infrared emission spectroscopy and visible/near-infrared reflectance spectroscopy of Fe-sulfate minerals. *American Mineralogist*, 100, 66-82, doi: 10.2138/am-2015-4762.

Larrasoaña J.C., **Roberts A.P.**, Liu Q.S., Lyons R., Oldfield F., **Rohling E.J.**, **Heslop D.** (2015) Source-to-sink magnetic properties of NE Saharan dust in Eastern Mediterranean marine sediments: review and paleoenvironmental implications. *Frontiers in Earth Science*, 3, doi: 10.3389/feart.2015.00019.

Lee S.-J., Rhie J., **Kim S.**, Kang T.S., Kim G.B. (2015) Ambient seismic noise tomography of the southern East Sea (Japan Sea) and the Korea Strait. *Geosciences*

Journal, 19, 709-720, doi: 10.1007/s12303-015-0012-7.

Lewis S.C., King A.D. (2015) Dramatically increased rate of observed hot record breaking in recent Australian temperatures. *Geophysical Research Letters*, 42, 7776-7784, doi: [10.1002/2015GL065793](https://doi.org/10.1002/2015GL065793).

Lewis S.C., LeGrande A.N. (2015) Stability of ENSO and its tropical teleconnections over the last millennium. *Climate of the Past*, 11, 1347-1360, doi: [10.5194/cp-11-1347-2015](https://doi.org/10.5194/cp-11-1347-2015).

Li H., **Hermann J.** (2015) Apatite as an indicator of fluid salinity: an experimental study of chlorine and fluorine partitioning in subducted sediments. *Geochimica et Cosmochimica Acta*, 166, 267-297.

Liu Q.S., Jin C.S., **Hu P.X.**, **Jiang Z.X.**, Ge K.P., **Roberts A.P.** (2015) Magnetostratigraphy of Chinese loess-paleosol sequences, *Earth-Science Reviews*, 150, 139-167.

Lopes C.G., Pimentel M.M., Philipp R.P., Gruber L., **Armstrong R.**, Junges S. (2015) Provenance of the Passo Feio complex, Dom Feliciano Belt: implications for the age of supracrustal rocks of the São Gabriel Arc, southern Brazil. *Journal of South American Earth Sciences*, 58, 9-17.

Louvel M., Bourdage A., Testamale D., Zhou L., **Mavrogenes J.A.** (2015) Hydrothermal controls on the genesis of REE deposits: Insights from an *in situ* XAS study of Yb solubility and speciation in high temperature fluids ($T < 400\text{ }^{\circ}\text{C}$). *Chemical Geology*, 417, 228-237.

Lowe J., Bronk Ramsay C., Housley R.A., Lane C., Tomlinson E.L., RESET team (incl. **Rohling E.J.**), RESET associates (2015) The RESET project: constructing a European tephra lattice for refined synchronisation of environmental and archaeological events during the last c. 100 ka. *Quaternary Science Reviews*, 118, 1–17.

Lupton J., Rubin K., **Arculus R.J.**, Lilley M., Butterfield D., Resing J., Baker E., Embley R. (2015) Helium isotope, C/He-3, and Ba-Nb-Ti signatures in the northern Lau Basin: distinguishing arc, back-arc, and hotspot affinities. *Geochemistry, Geophysics, Geosystems*, 16, 1133-1155.

Macphail M., Fifield L.K., **Pillans B.**, **Davies M.**, Hope G. (2015) Lake George revisited: new evidence for the origin and age of a large closed lake, Southern Tablelands, NSW, Australia. *Australian Journal of Earth Sciences*, 62, doi: [10.1080/08120099.2015.1108365](https://doi.org/10.1080/08120099.2015.1108365).

Maher W.A., **Ellwood M.J.**, Krikowa F., Raber G., Foster S. (2015) Measurement of arsenic species in environmental, biological fluids and food samples by HPLC-ICPMS and HPLC-HG-AFS. *Journal of Analytical Atomic Spectrometry*, 30, 2129-2183.

Maloney T., **Wood R.**, O'Connor S., Whitau R. (2015) Direct dating of resin hafted

point technology in Australia. *Australian Archaeology*, 81, 35-43.

Mann A., Reimann C., **De Caritat P.**, Turner N., Birke M., GEMAS Project Team (2015) Mobile Metal Ion® analysis of European agricultural soils: bioavailability, weathering, geogenic patterns and anthropogenic anomalies. *Geochemistry: Exploration, Environment, Analysis*, 15, 99-112, doi: 10.1144/geochem2014-279.

Marino G., Rohling E.J., Rodríguez-Sanz L., Grant K.M., Heslop D., Roberts A.P., Stanford J.D., Yu J. (2015) Bipolar seesaw control on last interglacial sea level. *Nature*, 522, 197–201.

Marino G., Zahn R. (2015) Agulhas Leakage: The Missing Link in the Interhemispheric Climate Seesaw? *Past Global Changes Magazine*, 23, 22–23.

Marschik R., **Kendrick M.A.** (2015) Noble gas and halogen constraints on fluid sources in iron-oxide-copper-gold mineralization: Mantoverde and La Candelaria, northern Chile, *Mineralium Deposita*, 50, 357-371.

Martínez-Botí M.A., Foster G.L., Chalk T.B., **Rohling E.J.**, Sexton P.F., Lunt D.J., Pancost R.D., Badger M.P.S., Schmidt D.N. (2015) Plio-Pleistocene climate sensitivity evaluated using high-resolution CO₂ records. *Nature*, 518, 49–53.

Martinez-Boti M.A., **Marino G.**, Foster G.L., Ziveri P., Henehan M.J., Rae J.W.B., Mortyn P.G., Vance D. (2015) Boron isotope evidence for oceanic carbon dioxide leakage during the last deglaciation. *Nature*, 518, 219–222.

Mayer W. (2015) Early attempts by Francois Péron and Louis Depuch to measure the temperature at various depths in the ocean, and their thoughts about a hot versus a cold interior of the Earth. *Earth Sciences History*, 34, 190-203.

McClusky S., Reilinger R., ArRajehi A. (2015) Geodetic constraints on the geodynamic evolution of the Red Sea. In: Rasul N., Stewart I.C.F. (Eds.), *The Red Sea*, 135-149, Springer Earth System Sciences, doi: 10.1007/978-3-662-45201-1_7.

McCoy-West A.J., Bennett V.C., O'Neill H.St.C., Hermann J., Puchtel I.S. (2015) The interplay between melting, refertilization and carbonate metasomatism in off-cratonic lithospheric mantle under Zealandia: an integrated major, trace and platinum group element study. *Journal of Petrology*, 56, 563-604.

McFadden R.R., Teyssier C., Siddoway C.S., Cosca M., **Fanning C.M.** (2015) Mid-Cretaceous oblique rifting of West Antarctica: emplacement and rapid cooling of the Fosdick Mountains migmatite-cored gneiss dome. *Lithos*, 232, 306-318, doi: 10.1016/j.lithos.2015.07.005.

McKibbin S.J., Ireland T.R., Amelin Y., Holden P. (2015) Mn–Cr dating of Fe- and Ca-rich olivine from ‘quenched’ and ‘plutonic’ angrite meteorites using Secondary Ion Mass Spectrometry. *Geochimica et Cosmochimica Acta* 157, 13–27.

Meissner K., **Abram N.**, Armand L., Chase Z., **De Deckker P., Ellwood M., Exon N., Gagan M.**, Goodwin I., Howard W., Lough J., McCulloch M., McGregor H., Moy

A., O'Leary M., Phipps S., Skilbeck G., Webster J., Welsh K., Zinke J. (2015) Dealing with climate change: palaeoclimate research in Australia. *Quaternary Australasia*, 32, 19-24.

Mendonidis P., Thomas R.J., Grantham G.H., **Armstrong R.A.** (2015) Geochronology of emplacement and charnockite formation of the Margate Granite Suite, Natal Metamorphic Province, South Africa: Implications for Natal-Maud belt correlations. *Precambrian Research*, 265, 189-202.

Meng Q., Heeszel D.S., Ye L., Lay T., Wiens D.A., Jia M., **Cummins P.R.** (2015) The 3 May 2006 (Mw 8.0) and 19 March 2009 (Mw 7.6) Tonga earthquakes: Intralab compressional faulting below the megathrust. *Journal of Geophysical Research*, 120, 6297-6316.

Mernagh T.P. (2015) A Review of Fluid Inclusions in Diagenetic Systems. *Acta Geologica Sinica (English Edition)*, 89, 697-714.

Mitchell N.C., Ligi M., **Rohling E.J.** (2015) Red Sea isolation history suggested by Plio-Pleistocene seismic reflection sequences. *Earth and Planetary Science Letters*, 430, 387–397.

Montillet J.P., Williams S.D.P., Koulali A., **McClusky S.** (2015) Estimation of offsets in GPS time-series and application to the detection of earthquake deformation in the far-field. *Geophysical Journal International*, 200, 1207-1221.

Montomoli C., Carosi R., **Rubatto D.**, Visona' D., Iaccarino S. (2015) Tectonic activity along the inner margin of the South Tibetan detachment constrained by syntectonic leucogranite emplacement in Western Bhutan. *Italian Journal of Geosciences*, 26, 1-27

Morrison A.K., England M.H., **Hogg A.McC.** (2015) Response of Southern Ocean convection and abyssal overturning to surface buoyancy perturbations. *Journal of Climate*, 28, 4263–4278, doi: 10.1175/JCLI-D-14-00110.1.

Morley A., **Heslop D.**, Rühlemann C., Mulitza S., Paul A., Schulz M. (2015) Detecting Holocene changes in the Atlantic meridional overturning circulation: integration of proxy data and climate simulations (DAMOCLES). In: Schulz M., Paul A. (Eds.) *Integrated analysis of interglacial climate dynamics (INTERDYNAMIC)*, SpringerBriefs in Earth System Sciences, 43-48.

Muir J.B., **Tkalčić H.** (2015) A method of spherical harmonic analysis in the geosciences via Bayesian hierarchical inference. *Geophysical Journal International*, 203, 1164-1171, doi: 10.1093/gji/ggv361.

Munday C., **De Deckker P.**, Tapper N.J., O'Loinsigh T., Alison G. (2015) Characterizing bacterial assemblages in sediments and aerosols at a dry lake bed in Australia using high-throughput sequencing. *Aerobiologia*, doi: 10.1007/s10453-015-9407-1.

Mustać M., Tkalčić H. (2015) Point source moment tensor inversion through a Bayesian hierarchical model. *Geophysical Journal International*, 204, 311-323, doi: 10.1093/gji/ggv458.

Muxworthy A.R., Williams J., **Heslop D.** (2015) Testing the use of viscous remanent magnetisation to date flood events. *Frontiers in Earth Science*, 3, doi: 10.3389/feart.2015.00001.

Myrow P.M., Chen J., Snyder Z., Leslie S., Fike D.A., **Fanning C.M.**, Yuan J., Tang P. (2015) Depositional history, tectonics, and provenance of the Cambrian-Ordovician boundary interval in the western margin of the North China block. *Geological Society of America Bulletin*, 127, 1174-1193, doi: 10.1130/B31228.1.

Nebel O., Arculus R.J. (2015) Selective ingress of a Samoan plume component into the northern Lau backarc basin. *Nature Communications*, 6, doi: 10.1038/ncomms7554.

Nebel O., Sossi P.A., Benard A., Wille M., Vroon P.Z., Arclius R.J. (2015) Redox variability and controls in subduction zones from an iron-isotope perspective. *Earth and Planetary Science Letters*, 432, 142-151.

Newsom H.E., Mangold N., Kah L.C., Williams J., Arvidson R.E., Stein N., Ollila A.M., Elston W.E., Bridges J., Schwenzer S., **King P.L.**, Grant J.A., Pinet P., Bridges N.T., Calef F., Wiens R.C., Vaniman D.T., Berger J., Garvin J.B., the MSL Science Team (2015) Gale crater and impact processes – observations during Curiosity's first 360 Sols on Mars. *Icarus*, 249, 108-128. doi: 10.1016/j.icarus.2014.10.013.

Norman M.D., Taylor L.A., Shih C.-Y., Nyquist L.E. (2015) Crystal accumulation in a 4.2 Ga lunar impact melt. *Geochimica et Cosmochimica Acta*, doi: 10.1016/j.gca.2015.09.021.

Nutman A.P., **Bennett V.C.**, Chivas A.R., Friend C.R.L.F., Liu X.M., Dux F.W. (2015) 3806 Ma Isua rhyolites and dacites affected by low temperature Eoarchaeon surficial alteration: Earth's earliest weathering. *Precambrian Research*, 268, 323-338.

Nutman A.P., **Bennett V.C.**, Friend C.R.L.F. (2015) The continent Itsaia amalgamated at 3.66 Ga and rifting apart from 3.45 Ga: Evidence and mechanism for a Wilson cycle at the start of the rock record. *American Journal of Science*, 315, 509-536.

Nutman A., **Bennett V.C.**, Friend C.R.L.F. (2015) The emergence of the Eoarchean proto-arc: Evolution of a ca. 3700 Ma convergent plate boundary at Isua, southern West Greenland. *Geological Society, London, Special Publications* 389, 113-133, doi: 10.1144/SP389.5.

Nutman A.P., **Bennett V.C.**, Friend C.R.L.F., Yi K., Lee S.,R. (2015) Mesoarchean collision of Kapisilik terrane 3070 Ma juvenile arc rocks and >3600 Ma Isukasia terrane continental crust (Greenland). *Precambrian Research* 258, 146-160, doi: 10.1016/j.precamres.2014.12.013.

Ohneiser C., Florindo F., Stocchi P., **Roberts A.P.**, DeConto R.M., Pollard D. (2015) Antarctic glacio-eustatic contributions to late Miocene Mediterranean desiccation and reflooding. *Nature Communications*, 6, 8765, doi: 10.1038/ncomms9765.

Okada T., Zolensky M.E., **Ireland T.R.**, Yada T. (2015) The Earth, Planets and Space Special Issue: "Science of solar system materials examined from Hayabusa and future missions", (Editorial), *Earth, Planets and Space* 67, 1-4.

Pachhai S., Dettmer J., Tkalčić H. (2015) Ultra-low velocity zones beneath the Philippine and Tasman Seas revealed by a trans-dimensional Bayesian waveform inversion. *Geophysical Journal International*, 203, 1302-1318, doi: 10.1093/gji/ggv368.

Pachhai S., Tkalčić H., Masters G. (2015) Estimation of splitting functions from Earth's normal mode spectra using the neighbourhood algorithm. *Geophysical Journal International*, 204, 111-126, doi: 10.1093/gji/ggv414.

Pankhurst R.J., Hervé F., **Fanning C.M.**, Calderón M., Niemeyer H., Griem-Klee S., Soto F. (2015) The pre-Mesozoic rocks of northern Chile: U–Pb ages, and Hf and O isotopes. *Earth Science Reviews*, 152, 88-105, doi: 10.1016/j.earscirev.2015.11.009.

Park J-W., Campbell I.H., Kim, J. (2015) Abundances of platinum group elements in native sulfur condensates from the Niuatahi-Motutahi submarine volcano, Tonga rear arc: Implications for PGE mineralization in porphyry deposits. *Geochimica et Cosmochimica Acta*, doi: 10.1016/j.gca.2015.11.026.

Park J-W., Campbell I. H., Kim J., Moon J-M. (2015) The role of late sulfide saturation in the formation of a Cu- and Au-rich magma: Insights from the platinum group element geochemistry of Niuatahi-Motutahi lavas, Tonga rear arc. *Journal of Petrology*, 56, 59-81, doi: 10.1093/petrology/ egu071.

Paterson G., **Heslop D.** (2015) New methods for unmixing sediment grain size data. *Geochemistry, Geophysics, Geosystems* 16, doi: 10.1002/2015GC006070.

Pawlik A., Piper P., **Wood R.**, Lim K.K.A., Faylona, M.G.P.G., Mijares A.S.B., Porr M. (2015) Shell tool technology in island Southeast Asia: an early Middle Holocene *Tridacna* adze from Ilin Island, Mindoro, Philippines. *Antiquity*, 344, 292-308.

Pereira M.F., Chichorro M., Moita P., Santos J.F., Solá A.M.R., **Williams I.S.**, Silva J.B., **Armstrong R.A.** (2015) The multistage crystallization of zircon in calc-alkaline granitoids: U-Pb age constraints on the timing of Variscan tectonic activity in SW Iberia. *International Journal of Earth Sciences*, 104, 1167–1183.

Pereira M.F., El Houicha M., Chichorro M., **Armstrong R.**, Jouhari A., El Attari A., Ennih N., Silva J.B. (2015) Evidence of a Paleoproterozoic basement in the Moroccan Variscan Belt (Rehama Massif, Western Meseta). *Precambrian Research*, 268, 61-73.

Perrett G.M., Campbell J.L., Gellert R., **King P.L.**, Nield E., O'Meara J.M., Pradler I.

(2015) Refinement of the Compton-Rayleigh scatter ratio method for use on the Mars Science Laboratory alpha particle X-ray spectrometer: II - Extraction of invisible element content. *Nuclear Instruments and Methods Physics Research B*, doi: 10.1016/j.nimb.2015.10.076.

Phillips G., Offler R., **Rubatto D.**, Phillips D. (2015) High-pressure metamorphism in the southern New England Orogen: implications for long-lived accretionary orogenesis in eastern Australia. *Tectonics*, 34, 1979-2010.

Pirard C., **Hermann J.** (2015a) Experimentally determined stability of alkali amphibole in metasomatised dunite at sub-arc pressures. *Contributions to Mineralogy and Petrology*, 169, 1-26. doi: 10.1007/s00410-014-1095-2.

Pirard C., **Hermann J.** (2015b) Focused fluid transfer through the mantle above subduction zones. *Geology*, 43, 915-918.

Pownall J.M. (2015) UHT metamorphism on Seram, eastern Indonesia: reaction microstructures and *P-T* evolution of spinel-bearing garnet-sillimanite granulites from the Kobipoto Complex. *Journal of Metamorphic Geology*, 33, 909-935, doi: 10.1111/jmg.12153.

Proske U., **Wood R.**, **Fallon S.**, Stevenson J. (2015) Use of heavy liquid density separation to remove pyrite from sediment samples for radiocarbon dating. *Quaternary Geochronology*, 25, 66-71.

Prouty N.G., Roark E.B., Andrews A., Robinson L., Hill T., Sherwood O., Williams B., Guilderson T., **Fallon S.** (2015) Age, growth rates, and paleoclimate studies of deep sea corals. In: Hourigan T.F., Etnoyer P.J., Cairns S.D., Tsao C.-F. (Eds.) *The state of deep-sea coral and sponge ecosystems of the United States: 2015*. NOAA Technical Memorandum X, NOAA, Silver Spring, 10-1 – 10-21.

Puga-Bernabéu Á., Webster J.M., Braga J.C., Clague D.A., Dutton A., **Eggins S.**, **Fallon S.**, Jacobsen G., Paduan J.B., Potts D.C. (2015) Morphology and evolution of drowned carbonate terraces during the last two interglacial cycles, off Hilo, NE Hawaii. *Marine Geology*, doi: 10.1016/j.margeo.2015.10.016.

Qing Q., **Hermann J.**, Wang Y., Guo J., Liu F., Wang L. (2015) Variations of clinopyroxene/melt element partitioning during assimilation of olivine/peridotite by low-Mg diorite magma. *Chemical Geology*, 419, 36-54.

Quijano J.E., Dosso S.E., **Dettmer J.**, Holland C.W. (2015) Fast computation of seabed spherical-wave reflection coefficients in geoacoustic inversion. *The Journal of the Acoustical Society of America*, 138, 2106-2117.

Rapela C.W., Verdecchia S.O., Casquet C., Pankhurst R.J., Baldo E.G., Galindo C., Murra J.A., Dahlquist J.A., **Fanning C.M.** (2015) Identifying Laurentian and SW Gondwana sources in the Neoproterozoic to Early Paleozoic metasedimentary rocks of the Sierras Pampeanas: Paleogeographic and tectonic implications. *Gondwana Research*, doi: 10.1016/j.gr.2015.02.010.

Rawlinson N., **Kennett B.L.N.**, **Salmon M.**, Glen R.A. (2015) Origin of lateral heterogeneities in the upper mantle beneath south-east Australia from seismic tomography. In: Kahn A., Deschamps F. (Eds.) *The Earth's Heterogeneous Mantle*, 47-78, doi: 10.1007/978-3-319-15627-9_2.

Reimann C., Ladenberger A., Birke M., **De Caritat P.** (2015) Low density geochemical mapping and mineral exploration: application of the mineral system concept. *Geochemistry: Exploration, Environment, Analysis*, doi: 10.1144/geochem2014-327.

Roberts A.P. (2015) Magnetic mineral diagenesis. *Earth-Science Reviews*, 151, 1-47.

Roderick M., Greve P., Farquhar G.D. (2015) On the assessment of aridity with changes in atmospheric CO₂. *Water Resources Research*, 51, doi: 10.1002/2015wr017031.

Rohling E.J., **Marino G.**, **Grant K.M.** (2015) Mediterranean climate and oceanography, and the periodic development of anoxic events (sapropels). *Earth Science Reviews*, 143, 62–97.

Rossi P., Cocherie A., **Fanning C.M.** (2015) Evidence in Variscan Corsica of a brief and voluminous Late Carboniferous to Early Permian volcanic-plutonic event contemporaneous with a high-temperature/low-pressure metamorphic peak in the lower crust. *Bulletin de la Société Géologique de France*, 186, 171-192, doi: 10.2113/gssgfbull.186.2-3.171.

Rosso I., **Hogg A.McC.**, Kiss A., **Gayen G.** (2015) Topographic influence on submesoscale dynamics in the Southern Ocean. *Geophysical Research Letters*, 42, 1139-1147.

Rubatto D., Angiboust S. (2015) Oxygen isotope record of oceanic and high-pressure metasomatism: a P-T-time-fluid path for the Monviso eclogites (Italy). *Contributions to Mineralogy and Petrology*, 170, 44.

Sanderman J., Baisden W.T., **Fallon S.** (2015) Redefining the Inert Organic Carbon Pool. *Soil Biology and Biochemistry*, 92, 149–52, doi: 10.1016/j.soilbio.2015.10.005.

Sanderman J., Krull E., Kuhn T., Hancock G., McGowan J., Maddern T., **Fallon S.**, Steven A. (2015) Deciphering Sedimentary Organic Matter Sources: Insights From Radiocarbon Measurements and NMR Spectroscopy, *Limnology and Oceanography*, 60, 739–53, doi: 10.1002/lno.10064.

Sangély L., Boyer B., De Chambost E., Valle N., Audinot J.N., **Ireland T.**, Wiedenbeck M., Aléon J., Jungnickel H., Barnes J.-P., Bienvenu P., Breuer U. (2015) Secondary Ion Mass Spectrometry. In: Prohaska T., Irrgeher J., Zitek A., Jakubowski N. (Eds.) *Sector Field Mass Spectrometry for Elemental and Isotopic Analysis*, 443-503.

Santos M.N., Chemale F., Dussin I.A., Martins M.S., Queiroga G., Pinto R.T.R., Santos A.N., **Armstrong R.** (2015) Provenance and paleogeographic reconstruction of a Mesoproterozoic intracratonic sag basin (Upper Espinhaço Basin, Brazil). *Sedimentary Geology*, 318, 40-57.

Satow C., Tomlinson E.L., **Grant K.M.**, Albert P.G., Smith V.C., Manning C.J., Ottolini L., Wulf S., **Rohling E.J.**, Lowe J.J., Blockley S.P., Menzies M.A. (2015) A new contribution to the Late Quaternary tephrostratigraphy of the Mediterranean: Aegean Sea core LC21. *Quaternary Science Reviews*, 117, 96–112.

Saygin E., **Cummins P.R.**, Pandhu R., Murjaya J., Irsyam M., **Hawkins R.**, Widiyantoro S., **Kennett B.L.N.** (2015) Imaging architecture of the Jakarta Basin, Indonesia with transdimensional inversion of seismic noise, *Geophysical Journal International*, doi: 10.1093/gji/ggv466.

Scealy J.L., **De Caritat P.**, Grunsky E.C., Tsagris M.T., Welsh A.H. (2015) Robust principal component analysis for power transformed compositional data. *Journal of the American Statistical Association*, 110, 136-148, doi: 10.1080/01621459.2014.990563.

Schmidt S., **De Deckker P.** (2015) Present-day sedimentation rates on the southern and southeastern Australian continental margins. *Australian Journal of Earth Sciences*, 62, 143-150.

Schwarz E., Spalletti L.A., Veiga G.D., **Fanning C.M.** (2015) First U-Pb SHRIMP age for the Pilmatué Member (Agrio Formation) of the Neuquén Basin, Argentina: Implications for the Hauterivian lower boundary. *Cretaceous Research*, 58, 223-233, doi: 10.1016/j.cretres.2015.10.003.

Schymanski S.J., **Roderick M.L.**, Sivapalan M. (2015) Using an optimality model to understand medium and long-term responses of vegetation water use to elevated atmospheric CO₂ concentrations, *Annals of Botany Plants*, 7, doi: 10.1093/aobpla/plv060.

Scussolini P., **Marino G.**, Brummer G.J., Peeters F.J.C. (2015) Saline Indian Ocean waters invaded the South Atlantic thermocline during glacial termination II. *Geology*, 43, 139–142.

Shen T., **Hermann J.**, Zhang L., Zeng L., Padron-Navarta J.-A., Bin X., Bader T. (2015) UHP metamorphism documented in Ti-chondrodite- and Ti-clinohumite-bearing serpentinized ultramafic rocks from Chinese Southwestern Tianshan. *Journal of Petrology*, 56, 1425-1458.

Singh A., Singh C., **Kennett B.L.N.** (2015) A review of crust and upper mantle structure beneath the Indian subcontinent, *Tectonophysics*, 644, 1-21, doi: 10.1016/j.tecto.2015.01.007.

Skinner L., McCave I.N., Carter L., **Fallon S.**, Scrivner A.E., Primeau F. (2015) Reduced ventilation and enhanced magnitude of the deep Pacific carbon pool during

the last glacial period. *Earth and Planetary Science Letters* 411, 45–52, doi: 10.1016/j.epsl.2014.11.024.

Skirrow R., Mercadier J., **Armstrong R.**, Kuske T. (2015) The Ranger uranium mineral deposit, northern Australia: Timing constraints, regional and ore-related alteration, and genetic implications for unconformity-related mineralisation. *Ore Geology Reviews*, doi: 10.1016/j.oregeorev.2015.09.001.

Snow K., Hogg A.McC., Downes S.M., Sloan B.M., Bates M.L., Griffies S.M. (2015) Sensitivity of abyssal water masses to overflow parameterizations. *Ocean Modelling*, 89, 84–103, doi: 10.1016/j.ocemod.2015.03.004.

Snow K., Hogg A.McC., Sloan B.M., **Downes S.M.** (2015) Sensitivity of Antarctic bottom water to changes in surface buoyancy fluxes. *Journal of Climate*, 29, 313–330, doi: <http://dx.doi.org/10.1175/JCLI-D-15-0467.1>.

Spencer E.T., Wilkinson J.J., Nolan J., **Berry A.J.** (2015) The controls of post-entrapment diffusion on the solubility of chalcopyrite daughter crystals in natural quartz-hosted fluid inclusions. *Chemical Geology*, 412, 15–25.

Steadman J.A., Large R.R., Meffre S., Olin P.H., Danyushevsky L.V., Gregory D.D., Belousov I., Lounejeva E., **Ireland T.R., Holden P.** (2015) Synsedimentary to early diagenetic gold in black shale-hosted pyrite nodules at the Golden Mile Deposit, Kalgoorlie, Western Australia. *Economic Geology* 110, 1157–1191.

Straub S.M., Gómez-Tuena A., Bindemann I.N., Bolge L.L., **Brandl P.A.**, Espinasa-Perena R., Solari L., Stuart F.M., Vannucchi P., Zellmer G.F. (2015) Crustal recycling by subduction erosion in the central Mexican Volcanic Belt. *Geochimica et Cosmochimica Acta*, 166, 29–52, doi: 10.1016/j.gca.2015.06.001.

Straub S.M., Woodhead J.D., **Arculus R.J.** (2015) Temporal evolution of the Mariana Arc: mantle wedge and subducted slab controls revealed with a tephra perspective. *Journal of Petrology*, 56, 409–439.

Suárez M., De La Cruz R., **Fanning M.**, Novas F., Salgado L. (2015) Tithonian age of dinosaur fossils in central Patagonian, Chile: U–Pb SHRIMP geochronology. *International Journal of Earth Sciences (Geol Rundsch)*, doi: 10.1007/s00531-015-1287-7.

Swift J., Cupper M.L., Greig A., Westaway M.C., Carter C., Cantoro C.M., **Wood R.**, Jacobsen G.E., Bertuch F. (2015) Skeletal arsenic of the pre-Columbian population of Caleta Vitor, northern Chile. *Journal of Archaeological Science*, 58, 31–45.

Tanaka S., Tkalčić H. (2015) Complex inner core boundary from frequency characteristics of the reflection coefficients of PKiKP waves observed by Hi-net. *Progress in Earth and Planetary Science*, doi: 10.1186/s40645-015-0064-3.

Thornalley D.J.R., Bauch H.A., Gebbie G., Guo W., Ziegler M., Bernasconi S.M., Barker S., Skinner L.C., **Yu J.** (2015) A warm and poorly ventilated deep Arctic

Mediterranean during the last glacial period. *Science*, 349(6249), 706-710.

Tanner D., Henley R.W., Mavrogenes J.A., Holden P., Mernagh T.P. (2015) Silica hydrate preserved with dO18-rich quartz in high-temperature hydrothermal quartz in the high sulfidation copper-gold deposit at El Indio, Chile. *Chemical Geology*, 391, 90-99.

Tierney J.E., **Abram N.J.**, Anchukaitis K.J., Evans M.N., Giry C., Kilbourne K.H., Saenger C.P., Wu H.C., Zinke J. (2015) Tropical sea-surface temperatures for the past four centuries reconstructed from coral archives. *Paleoceanography*, doi: 10.1002/2014PA002717.

Tkalčić H. (2015) Complex inner core of the Earth: The last frontier of global seismology. *Reviews of Geophysics*, 53/1, 59-94, doi: 10.1002/2014RG000469.

Tkalčić H., Young M.K., Muir J.B., Davies R., Mattesini M. (2015) Strong, multi-scale heterogeneity in Earth's lowermost mantle, *Nature Scientific Reports*, 5, article 18416, doi: 10.1038/srep18416.

Tollan P.M.E., O'Neill H.St.C., Hermann J., Benedictus A. and **Arculus R.J.** (2015) Frozen melt-rock reaction in a peridotite xenolith from sub-arc mantle recorded by diffusion of trace elements and water in olivine. *Earth and Planetary Science Letters*, 422, 169-181.

Tosi N., Stein C., Noack L., Huttig C., Maierova P., Samuel H., **Davies D.R.,** Wilson C.R., Kramer S.C., Thieulot C., Glerum A., Fraters M., Spakman W., Rozel A., Tackley P.J.A (2015) Community benchmark for viscoplastic thermal convection in a 2-D square box. *Geochemistry, Geophysics, Geosystems*, 16, 2175–2196, doi: 10.1002/2015GC005807.

Trotter J.A., **Williams I.S.,** Barnes C.R., Männik P., Simpson A. (2015) New conodont $\delta^{18}\text{O}$ records of Silurian climate change: implications for environmental and biological events. *Palaeogeography, Palaeoclimatology, Palaeoecology*, doi: 10.1016/j.palaeo.2015.11.011.

Trotter J.A., **Williams I.S.,** Nicora A., Mazza M., Rigo, M. (2015) Long-term cycles of Triassic climate change: a new $\delta^{18}\text{O}$ record from conodont apatite. *Earth and Planetary Science Letters*, 415, 165–174.

Tully B., Andrade K., **Brocks J.J.,** Emerson J., Allen E.E., Banfield J., Heidelberg K. (2015) De novo sequences of *Haloquadratum walsbyi* from Lake Tyrrell, Australia reveal a variable genomic landscape. *Archaea*, article 875784, doi: 10.1155/2015/875784.

Turner M., **Ireland T., Holden P., Hermann J.,** Turner S., Padron-Navarta J.A., Hauri E.H. (2015) Sensitive High Resolution Ion MicroProbe – Stable Isotope (SHRIMP-SI) analysis of water in silicate glasses and nominally anhydrous reference minerals. *Journal of Analytical Atomic Spectrometry*, 30, 1706-1722.

Vance T., Roberts J., Moy A., Curran M., Tozer C., Gallant A., **Abram N.**, van Ommen T., Young D., Blankenship D., Siegert M., Grima C. (2015) Optimal site selection for a high resolution ice core record in East Antarctica. *Climate of the Past Discussions*, doi: 10.5194/cpd-11-5073-2015.

Vreugdenhil C.A., Hogg A.McC., Griffiths R.W., Hughes G.O. (2015) Adjustment of the meridional overturning circulation and its dependence on abyssal and upper ocean mixing. *Journal of Physical Oceanography*, doi: 10.1175/JPO-D-15-0050.1.

Wang H., Fu B., Xu Z., Lu X., Lu J., Li H., Qu W., Yang X., Chen W., Zhang J. (2015) Geology, geochemistry, and geochronology of the Wangjiazhuang porphyry–breccia Cu (–Mo) deposit in the Zouping volcanic basin, eastern North China Block. *Ore Geology Reviews*, 67, 336-353.

Wang H., Xu Z., Lu X., **Fu B.**, Lu J., Yang X., Zhao Z. (2015) Two-types of Early Cretaceous adakitic porphyries from the Luxi terrane, eastern North China Block: Melting of subducted Paleo-Pacific slab and delaminated newly underplated lower crust. *Lithos*, 240-243, 140-154.

Wang J.-M., **Rubatto D.**, Zhang J.-J. (2015) Timing of Partial Melting and Cooling across the Greater Himalayan Crystalline Complex (Nyalam, Central Himalaya): In-sequence Thrusting and its Implications. *Journal of Petrology*, 56, 1677-1702.

Warner G.A., Dosso S.E., **Dettmer J.**, Hannay D.E. (2015) Bayesian environmental inversion of airgun modal dispersion using a single hydrophone in the Chukchi Sea. *The Journal of the Acoustical Society of America*, 137, 3009–3023.

Wasef S., **Wood R.**, El Merghani S., Ikram S., Curtis C., Holland B., Willerslev E., Millar C.D., Lambert D.M. (2015) Radiocarbon dating of Sacred Ibis mummies from ancient Egypt. *Journal of Archaeological Science: Reports*, 4, 355-361.

Weltje G.J., Bloemsma M.R., Tjallingii R., **Heslop D.**, Röhl U., Croudace I.W. (2015) Prediction of geochemical composition from XRF-core-scanner data: a new multivariate approach including automatic selection of calibration samples and quantitative uncertainties. In: Croudace I.W., Rothwell R.G. (Eds.) *Micro-XRF studies of sediment cores: A non-destructive tool for the environmental sciences*, 507-534.

Wiesmaier S., Morgavi D., **Renggli C.**, Perugini D., De Campos C., Hess K.U., Ertel-Ingrisch W., Lavallée Y., Dingwell D.B. (2015) Magma mixing enhanced by bubble segregation. *Solid Earth* 6, 1007-1023.

Wilford J., **De Caritat P.**, Bui E. (2015) Modelling the abundance of soil calcium carbonate across Australia using geochemical survey data and environmental predictors. *Geoderma*, 259-260, 81-92, doi: 10.1016/j.geoderma.2015.05.003.

Wilford J., **De Caritat P.**, Bui E. (2015) Predictive geochemical mapping using environmental correlation. *Applied Geochemistry*, doi: 10.1016/j.apgeochem.2015.08.012.

Wimpenny J.B., **Amelin Y.**, Yin Q.Z. (2015) The Lu isotopic composition of achondrites: closing the case for accelerated decay of ^{176}Lu . *The Astrophysical Journal Letters*, 812, L3.

Wood R. (2015) From convention to revolution: the past, present and future of radiocarbon dating. *Journal of Archaeological Science*, 56, 61-72.

Wykes J.L., O'Neill H.StC., Mavrogenes J.A. (2015) The effect of FeO on the sulfur content at sulfide saturation (SCSS) and the selenium content at selenide saturation of silicate melts. *Journal of Petrology*, 56, 1407-1424.

Xue Y., Campbell I.H. (2015) The mineralogy of the Bellerophon-Nelson Telluride-bearing gold deposit, St Ives Camp, Yilgarn Craton, Western Australia. *The Canadian Mineralogist*, 52:981, doi: 10.3749/canmin.4352.

Yakymchuk C., Brown C.R., Brown M., Siddoway C.S., **Fanning C.M.**, Korhonen F.J. (2015) Paleozoic evolution of western Marie Byrd Land, Antarctica. *Geological Society of America Bulletin*, 127, 1454-1484, doi: 10.1130/B31136.1.

Yang Y., Donohue R.J., McVicar T.R., **Roderick M.L.** (2015) An analytical model for relating global terrestrial carbon assimilation with climate and surface conditions using a rate-limitation framework. *Geophysical Research Letters*, 42, doi: 10.1002/2015gl066835.

Yoshizawa K., **Kennett B.L.N.** (2015) The lithosphere-asthenosphere transition and radial anisotropy beneath the Australian continent. *Geophysical Research Letters*, 42, 3839–3846, doi: 10.1002/2015GL063845.

Zhang F., Jin Z.D., **Yu J.**, Zhou Y., Zhou L. (2015) Hydrogeochemical processes between surface and groundwaters on the northeastern Chinese Loess Plateau: Implications for water chemistry and environmental evolutions in semi-arid regions. *Journal of Geochemical Exploration*, doi: 10.1016/j.gexplo.2015.08.010.

Zhao X., Heslop D., Roberts A.P. (2015) A protocol for variable-resolution first-order reversal curve (FORC) measurements. *Geochemistry, Geophysics, Geosystems*, 16, 1364-1377.

Zinke J., McGregor H.V., **Abram N.J.**, Lough J.M., **Gagan M.**, O'Leary M., McCulloch M., Webster J., Woodroffe C. (2015) Dealing with climate change through understanding past tropical ocean-atmosphere climate interactions and their impacts on marine ecosystems. *Quaternary Australasia*, 32, 25-31.

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