Australian National University

Research School of Earth Sciences

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ANNUAL REPORT 2022

CRICOS Provider #00120C

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Credit: Shihao Jiang (left) , Bowen Fang (right)

FROM THE DIRECTOR

In 2022 the RSES community felt significant recovery from the COVID-19 pandemic and related complications. With travel picking back up again, most of our students and staff were able to catch up with family and friends far away and re-establish contact with colleagues in person rather than on computer screens. The repair of our School's many roofs – all damaged by a freak hail shower in 2019 –picked up speed but will cast a shadow for most of this year and into 2025 with repeated office relocations and more unexpected additional repairs to our buildings.

The year started with the devastating loss of Professor Leanne Armand who passed away after a short and grave illness. Leanne leaves behind a strong legacy of outstanding marine research and caring supervision. Our thoughts are with her family and friends.

The School community came together at several online retreats to craft a new strategic plan for the School that will guide us for the next 5 years. This plan identifies our areas of strength in Earth Structure and Dynamics, Climate and Ocean, Critical Resources for the 21st Century and Beyond, and Origins and Evolution of Earth and Life. It also articulates our unwavering commitment to fundamental research and to excellence in educating the next generation of earth scientists.

2022 also allowed us to celebrate some outstanding individual successes: Prof. Andrew Roberts was awarded the Mawson Medal by the Australian Academy of Science and Dr. Adele Morrison won the Malcolm McIntosh Prize for Physical Scientist of the Year, which is one of the Prime Minister's Prizes for Science.

A significant milestone was reached on June 23rd with the launch of the Australian Earth System Simulator (ACCESS-NRI), which marked Prof Andy Hogg's transition from RSES to his new role as ACCESS-NRI Director for the coming five years. Prof Jimin Yu continued to pursue his research abroad on a scholarship at Qingdao Ocean Science and Technology National Laboratory in China.

Overall, 2022 was a successful year marked by impactful research and face-to-face teaching, as activity and travel slowly returned while the world edges towards a new 'normal'.

STAFF LISTS

ACADEMIC STAFF

Director

D. Jacob, Dr. rer. nat. Georg August University Germany (equivalent PhD) Diplom in Mineralogy, Johannes Gutenberg Univ, Germany (equivalent MSc)

Associate Directors

Research	N.J. Abram, BSc Advanced (Hons) Sydney, PhD ANU
Higher Degree Research	S.J. Fallon, BA MS San Diego, PhD ANU
Education	M.J. Ellwood, BSc (Hons) PhD Otago
Engagement	M.S. Miller, BA Whittier, MSc Columbia, MEng Cornell, PhD ANU
Honours	C. Shakespeare, BSc (Hons) ANU, PhD Cambridge
Master	D.C. Heslop, BSc Durham, PhD Liverpool

Professors

N.J. Abram, BSC Advanced (Hons) Sydney, PhD ANU
A.J. Berry, BSc (Hons) Sydney, DPhil Oxford
J.J. Brocks, Dip Freiburg, PhD Sydney
P.R. Cummins, BA Physics, PhD UC Berkeley
M.J. Ellwood, BSc (Hons) PhD Otago
S.J. Fallon, BA MS San Diego, PhD ANU
A.M. Hogg, BSc ANU, PhD UWA (to 29/03/2022)
P.L. King, BSc (Hons) ANU, PhD Arizona State
J.A. Mavrogenes, BS Beloit, MS Missouri-Rolla, PhD Virginia Tech
M.S. Miller, BA Whittier, MSc Columbia, MEng Cornell, PhD ANU
L.N. Moresi, BA (Hons) Cambridge, DPhil Oxford
A.P. Roberts, BSc Massey, BSc (Hons) PhD DS Victoria (Wellington)
E. Rohling, BSc MSc PhD Utrecht
M.S. Sambridge, BSc Loughborough, PhD ANU, FAA, FRAS
H. Tkalčić, DipEng in Physics Zagreb, PhD UC Berkeley
M.L. Roderick, BAppSc QUT, PGDipGIS Qld, PhD Curtin (to 31/07/2020)
E. Rohling, BSc MSc PhD Utrecht
M.S. Sambridge, BSc Loughborough, PhD ANU, FAA, FRAS
H. Tkalčić, DipEng in Physics Zagreb, PhD UC Berkeley
P. Tregoning, BSurv PhD UNSW
G.M. Yaxley, BSc PhD Tasmania

Associate Professors

D.R. Davies, MSci PhD Cardiff, UK
M.A. Forster, BSc MSc PhD Monash
R. Hackney, BSc (Hons) ANU, MSc Victoria University of Wellington, PhD UWA - IODP Director (from 01/07/2022)
D.C. Heslop, BSc Durham, PhD Liverpool
J. Yu, BSc MSc Nanjing University, PhD Cambridge

Fellows

C. Eakin, MSc Imperial College London, PhD Yale [ARC DECRA Fellow to 30/03/2022]
A. Kiss, BSc (Hons) PhD ANU
C. Shakespeare, BSc (Hons) ANU, PhD Cambridge
A. Valentine, BA MSc Cambridge, DPhil Oxford (to 31/01/2022)

Research Fellows

S. Allgeyer, PhD Paris Diderot, France (to 12/02/2022)
M. Anenburg, BSc MSc Ben-Gurion University of the Negev Israel, PhD ANU
A. Burnham, MSci MA Cambridge, PhD Imperial College London
N.C. Constantinou, BSc MSc PhD Athens, Greece [ARC DECRA Fellow]
K. Grant, BSc Southampton, MSc JCU, PhD Southampton
D. Guerer, BSc Bonn, MSc Oslo, PhD Utrecht (to 31/05/2022)
M. Hoggard, BA MSc in Natural Sciences PhD Cambridge [ARC DECRA Fellow from 01/08/2022]
C. Holgate, BEng UNSW, M.Hydrology Vrije Universiteit Amsterdam, PhD ANU (from 14/02/2022)
W. Huneke, BSc MSc Kiel, PhD Tasmania
C. Jiang, BS and graduate study in geology China Univ of Geosciences, PhD Macquarie [ARC DECRA Fellow from 21/03/2022]
S. McKibbin, BSc (Hons) Newcastle, PhD ANU
L. Miller, MSc Imperial College London, PhD ANU (from 28/11/2022)
A. Morrison, BSc (Hons) ANU, GradDipEd Canberra, PhD ANU [ARC DECRA Fellow]
A. Purcell, BSc (Hons) PhD ANU (from 16/05/2022)
K. Stewart, BSc (Hons), PhD ANU
R. Wood, BSc (Hons) Durham, MSc DPhil Oxford (to June 2022)

Postdoctoral Fellows

A. Casas Ramos, BChemEng Tuxtla ITTG, MGeochem (UNAM), Dr. rer. nat. Ludwig-Maximillans-Universitat Munchen (from 14/02/2022)
J. D'Andres, (from 10/03/2022)
T. Duvernay, BSc MSc Universite Paris Diderot (from 03/10/2022)
G. Falster, BSc (Hons) PhD Adelaide
S. Ghelichkhan, BSc Tehran, MSc PhD Ludwig-Maximillans-Universitat Munchen
V.H. Lai, BA UC Berkeley, MSc PhD California Inst of Technology
X. Ma, BSc Zhejiang University, PhD Chinese Academy of Sciences
P. Martin, A.B. with cum laude honours Harvard, PhD Michigan (to 30/04/2022)
R. McGirr, BSc (Hons) Sydney, PhD ANU (from 19/04/2022)
L. Otter, BSc JGU, MSc joint JGU and MPIC, PhD Macquarie
T.S. Pham, BEng Hanoi, Postgrad Dip Intl Center for Theoretical Physics, PhD ANU
R. Pickle, BS UC at Davis, MSc Brown, PhD Auckland
S.M. Razeghi, MSc Tehran, PhD Newcastle
Z. Sudholz, BSc Monash, BSc (Hons) UWA, PhD ANU (from 10/01/2022)
S. Wang, BSc (Hons) Wuhan, MSc Univ Chinese Acad Sci, PhD ANU (from 23/05/2022)
H. Yang, Bachelor Jilin Univ, Master Copenhagan, PhD Melb

Postdoctoral Fellows cont.

P. Zhang, BSc Jilin Univ, MSc Univ Sci&Tech China, PhD ANU (from 07/06/2022)
X. Zhao, BSc Jilin University, PhD Southampton (to 30/09/2022)

Emeritus Professors

R.J. Arculus, BSc PhD Durham, FAIMM
V. Bennett, BSc PhD UCLA
I.H. Campbell, BSc UWA, PhD DIC London
S.F. Cox, BSc UTas, PhD Monash
P. De Deckker, BA MSc (Hons) Macquarie, PhD DSc Adelaide
S. Eggins, BAppSci UNSW, PhD Tasmania
D.J. Ellis, MSc Melbourne, PhD Tasmania
N.F. Exon, BSc (Hons) UNSW, PhD Kiel
D.H. Green, BSc MSc DSc DLitt (Hon) UTas, PhD Cambridge, FAA, FRS
R.W. Griffiths, BSc PhD ANU, FAIP, FAA
R. Grun, Diplo Geol, Dr.rer.nat.habil Köln, DSc ANU, FAAH
I.N.S. Jackson, BSc Qld, PhD ANU, FAA
B.L.N. Kennett, MA PhD ScD Cambridge, FAA, FRS
K. Lambeck, BSurv NSW, DPhil DSc Oxford, FAA, FRS
H. O'Neill, BA Oxford, PhD Manchester, FAA, FRS
B.J. Pillans, BSc PhD ANU, HonFRSNZ
M. Roderick, BAppSc QUT, PGDipGIS Qld, PhD Curtin
J.S. Turner, MSc Sydney, PhD Cambridge, FIP, FAIP, FAA, FRS (to 03/07/22)
I.S. Williams, BSc PhD ANU

Emeritus Fellow

M.D. Norman, MSc Tennessee, PhD Rice

Honorary Professors

H. Davies, BSc MSc UWA, PhD Stanford (to 31/12/2022)
R.A. Eggleton, BSc (Hons) Adelaide, PhD Wisconsin, DSc Adelaide (to 18/01/2022)
S. Foley, BSc (Hons) Southampton, MSc Memorial Univ Newfoundland, PhD Tasmania
C.B. Foster, BSc (Hons) Adelaide, PhD Qld
A. Gerson, PhD Strathclyde Scotland
T. Ireland, BSc Otago, PhD ANU
W. Maher, BAppSci (Hons) MAppSci Melbourne, PhD Southampton
N. Williams, BSc (Hons) ANU, MPhil PhD Yale
L. Wyborn, BSc (Hons) Sydney, Dip Ed UC, PhD ANU

Honorary Associate Professors

Y. Amelin, MSc PhD Leningrad State
R.A. Armstrong, BSc MSc Natal, PhD Witwatersrand
R.V. Burne, BSc Wales, DPhil Oxford
T. Esat, BSc Univ College London, MSc Queens Univ Canada, PhD ANU
C.M. Fanning, BSc Adelaide
G.M. Gibson, BSc Edinburgh, PhD Otago
M. Honda, MSc PhD Tokyo (to 31/12/2022)

Honorary Associate Professors Cont.

A. Jaques, BSc (Hons) WA, PhD Tasmania
R.C. Kerr, BSc Qld, PhD Cambridge, FAIP (to 31/12/2022)
F. Lilley, BSc (Hons) Sydney, MSc PhD Western Ontario
S. McClusky, BSurv PhD UNSW
T. Mernagh, BSc (Hons) PhD Newcastle
B. Opdyke, AB Columbia, MS PhD Michigan
R. Skirrow, BSc WA, Postgrad Dip Sci (Hons) Newcastle, MSc Carleton Univ, PhD ANU
Y. Yang, BS Univ SciTech China, PhD Brown (to 15/07/2022)

Honorary Senior Lecturers

G. Marino, MSc (cum laude) 'Federico II' of Naples; PhD Utrecht
R.P. Rapp, BA State University of New York, PhD Rensselaer Polytechnic Institute (to 31/12/2022)
A. Valentine, BA MSc Cambridge, DPhil Oxford

Honorary Lecturers

S. Allgeyer, PhD Paris Diderot, France (from 17/06/2022)
L. Bean, BSc Sydney, DipEd Syd Teachers College, Grad Dip, PhD ANU
M.W. Forster, Diplom Geologist (MSc equiv) PhD Macquarie
J. Nunes Avila, BSc MSc UFRGS, PhD ANU
A. Rosenthal, MSc Tech Univ Bergakademie Freiberg, PhD ANU

Visiting Fellows

W. Compston, BSc PhD DSc (Hon) UWA, FAA, FRS
G.F. Davies, MSc Monash, PhD CalTech (to 31/01/2022)
P. De Caritat De Peruzzis, PhD ANU (to 31/08/2022)
J. Foster, BSc Sydney, MSc PhD ANU (from 15/02/2022)
L. Frankcombe, BSc (Hons) ANU, PhD Utrecht (to 26/09/2022)
A. Hirsch, BSc (Hons) ANU, PhD UNSW (to 11/02/2022)
T. Gruetzner-Handke, Diploma Geology (equiv Masters) Universitat Mainz, Dr.rer.Nat. Westfalische Wilhelms Universitat Munster (from 01/07/2022)
D. Ham, LLB BSc (Hons) ANU, PhD TUDelft (from 01/04/2022 to 31/08/2022)
D. Hutchinson, PhB (Hons) ANU, PhD UNSW
K. Jones, BSc (Hons) ANU, PhD Bristol
A. Kimbrough, BSc Arizona, PhD ANU (to 29/11/2022)
C. Klootwijk, BSc MSc PhD Utrecht
D. Mole, MSc Univ College London, PhD UWA (from 12/05/2022)
C. Morales Yanez, BSc MSc Universidad de Concepcion, PhD Universite de Strasbourg (from 25/09/2022 to 14/11/2022)
P. O'Brien, BSc (Hons) PhD Melbourne (from 28/04/2022)
M. Rigo, Master in Natural Sci cum Laude PhD Padova, (from 04/01/2022)
G.J. Stanley, BS Maths Univ Waterloo, MSc Univ Victoria, PhD Oxford (to 39/09/2022)
M. Valetich, BSc (Hons) PhD ANU (from 10/02/2022)
Z. Zhou, BSc Guilin Univ of Tech, MSc PhD Chinese Academy of Geological Sciences

PROFESSIONAL STAFF

School Manager	G.F.M. Pearson, BA, BTh, MBA, FAIM
Executive Assistant to the Director & the School Manager	S. Devi (to 14/01/2022) T. Adams (from 09/05/2022)
Administration Manager	V. Riddle, Dip Leadership & Management AIM
Building and Facilities Officer	E. Ward, Cert V Frontline Management, Quest/ANU
WHS Officer	N. Papparlado (from 10/01/2022)
Education Developer	H. McGregor, BSc, GradDipEd (Science) (from 08/08/2022)
Education Support Officer	K. Thow, BA Macquarie, MPhil (Current) (from 28/11/2022) T. Penny, BSc (Hons) Qld (to 05/08/2022)
Communications Officer	L. Medenis
Receptionist	G. Alvarez Rodriguez, BSc University of Texas, MPhil (Current) (from 12/09/2022) D. Neale, BSc Canberra (to 13/09/2022)
Research Group Administrators	J. Magro A. Daley, Cert IV Procurement & Contracts
IODP/ANZIC Program Manager	S. Kachovich, Bsc (Hons) UOW, PhD University of Queensland
IODP Administrator	K. Kenney
Administrator for Centre of Excellence Climate Extremes	C. Tucker (from 14/02/2022)

Laboratory Operations

Manager	A. Latimore, BEng University of Canberra
Technical Support	C. Bryant, BSc (Hons) New England, PhD ANU (to 08/05/2022) D. Clark, Cert III Metal Fabrication AdvDipEng CIT R. Esmay, BSc (Sr Thesis) SUNY Purchase P. Hu, PhD ANU & Chinese Academy of Sciences P. Lanc, AssocDip Bus (Applied Computing) CIT Y. Liu, BEng MEng ANU (from 04/10/2022) H. Miller, AdDipMechEng CIT T. Redman, Assoc Dip (Elect Eng) CIT (to 28/01/2022) A. Rummery, Cert III CIT (x3) H. Sasaki, AssocDip CIT H. Williams, BA MAESc ANU, MForSc Western Sydney (to 27/04/2022)

Geochemical Analysis

Manager	B. Knowles, BSc PhD Wollongong
Technical Support	B. Chen, (from 27/06/2022) T. Cheng, BEng Hefei College, China, PhD USTC China (to 10/06/2022) B. Fu, BSc Chungchun, MSc Nanjing, PhD Vrije R. Grun, BSc (Hons) ANU (from 15/08/2022) J. Hope, BSc James Cook X. Ji, BSc NUIST, MSc (Adv) ANU (from 11/07/2022) M. Misztela, BA MA AGH Univ of Science & Technology, Poland (to 03/06/2022) L. Rodriguez Sanz, BSc Venezuela, MEnvStudies, PhD Autonomous (Barcelona) D. Vasegh, AssocDeg Khajeh Nasireddin Toosi University of Technology (Iran) Y. Wu, BEng China Univ, MSc Univ Newfoundland, PhD ANU (from 10/10/2022) W. Xiao, BEng (Hons) Hunan, PhD UNSW (from 04/07/2022) S. Zink, BSc Hanover, Diploma (MSc) Hanover

Geophysical Data & Computation

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

Staff List

Technical Support	J. Byrne, BSc (Hons) ANU, PhD Monash R. Erigela, BTech Jawaharlal Nehru Technological University, PGDip NIELIT-India, MScEng Swinburne A. Gibson, BCompSci (Hons) PhD ANU A. Heerdegen, BSc (Hons) Massey, PhD ANU (to 10/07/2022) P. Kaduru, Bach Electronics & Comm Eng Jawaharlal Tech, Masters in IT Charles Sturt G. Luton, BSurv UNSW (to 30/06/2022) S. Mousavi, BSc MSc, Tehran University, PhD Leipzig M. Salmon, BSc (Hons) PhD Victoria (Wellington) J. Tatapudi, BEng Jawaharlal Nehru Technological University, GradDip in Business Information Systems Federation University Melbourne, AdvDip Leadership & Management Mercury Institute of Victoria (to 30/09/2022)
Scientific Programmers	J. He, Bachelor of IT (Hons) ANU H. Hollmann, MSc Kiel, PhD Tasmania
Software Engineer	M. Tourdot de Oliveira, BSc PhD Coimbra (from 14/03/2022)
Technical/Research Officers	K. Hayward, BCom Wollongong, MNHD MPhil PhD ANU (from 17/10/2022) L. Velasquez Jimenez, BSc Pontificia Universidad Javeriana, MSc PhD James Cook (from 17/10/2022) Y. Qian, BEng Anhui Univ, MSc Beijing Normal Univ, PhD ANU (from 12/12/2022) Y. Wang (from 25/07/2022) X. Zhao, BSc Jilin University, PhD Southampton (from 1/10/2022)

Credit: Jun Liu (left)& Rajesh Reddy (right)

POST-GRADUATE STUDENTS

PhD Candidates

Agrawal, Shubham
Amarathunga, Udara
Arcot Parthiban, Ramkumar
Baeza, Leonardo
Baile, Riley
Barnes, Ashley
Bhagtani, Dhruv
Bilton, Leon
Bishop, Caleb
Bonning, Geoffrey
Cajal Contreras, Yamila
Carrasco Godoy, Carlos
Chandler, Ross
Chen, Fangqin
Connolly, Clare
Costa de Lima, Thuany
Devi, Riteshma
Di, Yankun
Dodd, Lachlan
Du, Haoran
Durgalakshmi
Duvernay, Thomas
Egbo, Miracle
Eggins, Sam
Fang, Bowen
Gao, Yajie
Gray, Sharon
Grun, Robin
Harazin, Katie
Hargreaves, Jessica
Hsu, Shao-Chen
Hu, Jinyin
Huang, Zhijie
Ingles, Christopher
Jackson, Sarah
Ji, Xuan
Jiang, Shihao
Jones, Alysha
Kinsley, Jordan
Kirby, Rachel
Kou, Yingxin
Krestianinov, Evgenii
Lawler, Kelly-Anne
Leong, Kit
Leong, Timothy
Liyanage, Tharika
Loidolt, Christina
Lu, Neng
Maharaj, Prayna
Makushkina, Anna
Martin, Stacey
McConachie, Shannon
Medd, Oliver
Naina
Nakrong, Nipaporn
Nugraheni, Rosmalia
Nugroho, Hendro
O'Brien, Helen (Jane)
Owens, Ryan
Pandey, Abhay
Pasic, Bozana
Patkar, Aditya
Piedrahita Velez, Victor
Rama, Jemima
Ray, Srijita
Roosmawati, Nova
Ry, Rexha
Sakti, Artadi
Scheiter, Matthias
Sebastian, Nita
Sembatya, Naiga (Erios)
Sholeninova, Polina
Sun, Yaojia
Sweetman, James
Turunctur, Buse
Weber, Rikki
Wenham, Lana
Wilsbacher, Catherine
Wu, Jaide
Ye, Tao
Yeung, HoSonia
Yung, Claire
Zhang, Ping
Zhao, Siyuan
Zhao, Song
Zhu, Ziyi

MPhil Candidates

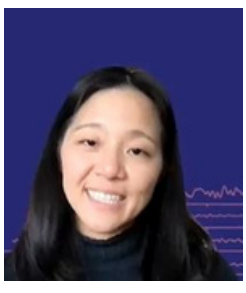
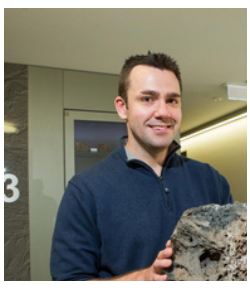
Alvarez Rodriguez, Guadalupe
Wu, Yunqi (Yoli)

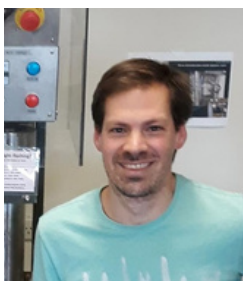
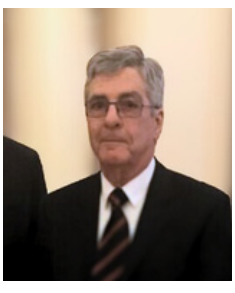
STAFF HONOURS & AWARDS

STAFF MEMBER	AWARD	AWARDING BODY
Prof. A. Roberts	2022 Mawson Medal	Australian Academy of Science
Dr. A. Morrison	2022 Malcolm McIntosh Price Physical Scientist of the Year	Commonwealth of Australia
Prof. H. Tkalčić	Vice-Chancellor's Award for Excellence in Supervision 2022	Australian National University
Dr. P. Cummins	Federal Public Service Medal	Commonwealth of Australia
Dr. C. Eakin	2022 Outstanding Early Career Scientist Award	European Geosciences Union
Prof. H. Tkalcic	2022 Price Medal	Royal Astronomical Society
Dr. M. Anenburg	SEG Waldemar Lindgren Award	Society of Economic Geologists
Dr. R. Davies	2022 Harold Jeffreys Lectureship	Royal Astronomical Society
Dr. V. Hui Lai	AuScope's biannual science communication award	AuScope
Prof. H. Tkalčić	2022 President Distinguished Scientist Award	Chinese Academy of Science
Prof. J. Brocks	The Australian Organic Geochemistry Medal	AOGC
Prof. I. Campbell	Haddon Forrester King Medal	Australian Academy of Science





THESES AND AWARDS

PhD theses completed (Supervisor in parentheses)

Chen, Bei “Growth of the Preserved Continental Crust: Integrated U-Pb, O, and Hf isotopic systematics of detrital zircons from Australia and Antarctica” (Greg Yaxley)

Chen, Mimi “Multi-sulfur isotopes of Neoarchean pyrites from the Yilgarn Craton, Western Australia” (Ian Campbell)

Gluchowska, Jessika “Sediment subduction: Geochemical Implications for Mantle Metasomatism” (Ian Campbell)

McGirr, Rebecca “Estimating Earth's temporal gravity field from GRACE observations: Mitigation of thermal errors and the interplay between orbital characteristics, basis functions and spatial resolution” (Paul Tregoning)

Misztela, Monika “Application of platinum-group element (PGE) geochemistry to select geological problems” (Ian Campbell)

Qu, Tongzhang “Microstrain mechanical testing of ultramafic materials: the onset of anelastic relaxation, its grainsize sensitivity, and the role of orthopyroxene” (Ian Jackson)

Sudholz, Zachary “Geothermobarometry of garnet-bearing peridotites, pyroxenites and eclogites and a mantle view of the South Aust. Craton and Phanerozoic Tasmanides: Petrological constraints on lithospheric architecture, mantle lithology and geochemistry” (Greg Yaxley)

Wang, Sheng “Seismic Event Coda-Correlation Imaging of the Earth's Interior” (Hrvoje Tkalcic)

MPhil thesis completed (Supervisor in parentheses)

Moller, Bruno “The Essentials of Alkali Metals: A review of the field and advances towards a multi-element method” (Stewart Fallon)

Master of Earth Sciences (Advanced) (Supervisor in parentheses)

Cheng, Ming “Developing a one-dimensional model to probe the iron cycle in lakes” (Michael Ellwood)

Gao, Yiyuan “Geochemistry of the critical metal niobium” (Andrew Berry)
Hangyu Meng “The dynamics of southern subpolar gyres in different resolution models” (Andy Hogg)

Johnson, Liam “Carrara 1 drill core biomarker analysis” (Jochen Brocks)

Yang, Chengcheng “Total water storage changes recovery using daily vertical GPS displacement measurements” (Mahdiyeh Razeghi)

Zhang, Fan “The role of wind stress in the separation latitude of east Australian current” (Andrew Kiss)

Honours (Supervisor in parentheses)

Alice Kelly "Tracking the transformation of primary production after the P/T mass extinction" (Jochen Brocks)

Amelia Lewis "Exploring new ways to extract rare earth elements from the mineral allanite" (Greg Yaxley)

Anastasia-Filia Morfiadakis "Investigating the Termination of the Messinian Salinity Crisis" (Katharine Grant)

Datta, Chitrangada "Deformation Processes and Kinematic Evolution of the Murrumbidgee Fault Zone" (Stephen Cox)

Dodd, Lachlan "Late Mission GRACE Estimates and the Impact of Gaps in Measurements of Inter-Satellite Range" (Paul Tregoning)

Edgar Leong "Exploring the geodynamic setting of five-element veins" (Mark Hoggard)

Emma Fitzgerald "Environmental Record Reconstruction using Corals" (Stewart Fallon)

Erin Barr "Pangolin Scale Analysis" (Rachel Wood)

Hannah Loiterton "Characterization and formation of oxalate mineral coatings" (Penny King)

Holly Ma "Iron and its role in regulating Ocean Phytoplankton growth" (Michael Ellwood)

Imogen McDermott "Biomolecular search for the rise of crown-group eukaryotes" (Jochen Brocks)

Jemma Jeffree "Measuring AABW export variability with satellite altimetry" (Andy Hogg)

Kathryn Keane "Experimental petrology in the Bushveld chromites" (Michael Anenburg)

Lauren Schenk "Investigatingthe partition coefficient of REEs into mantle garnets and clinopyroxene" (Greg Yaxley)

Lewis, Samuel "Landscape function and climate as primary stressors of Eucalyptus blakelyi dieback, yass-murrumbateman, NSW, Australia." (Leah Moore)

Marissa Higgins "The geology, mineralogy and geochemistry of the Yin ironstone-hosted REE prospect (Western Australia): Implications of near-surface weathering on the mineralogy and geochemistry of carbonatites" (John Mavrogenes)

Medd, Oliver "An Oxygen Isotope-based Seawater Paleothermometer Calibration using Anadara trapezia Bivalves Grown in Aquaculture" (Laura Otter)

Palm, William "Laboratory investigation of brine channel properties" (Kial Stewart)

Ruby Turner "Exploring the use of geochemical observations in reconstructing the spatial and temporal evolution of mantle flow" (Rhodri Davies)

Tatnell, Lucas "The origins of high La/Yb in adakites and porphyry-forming intrusions: Arcphibolites and Arclogites" (Michael Anenburg)

Honours (Supervisor in parentheses) cont.

Trihey, James "Unravelling the mysteries of Southern Ocean deep-water masses during the Late Quaternary" (Michael Ellwood)

Xulu, Lin "Imagining the lithosphere of Zealandia" (Meghan Miller)

STUDENT HONOURS & AWARDS

Higher Degree Research	
DA Brown Travel Fellowship	Srijita Ray
Mervyn & Katalin Paterson Fellowship	Caleb Bishop Rachel Kirby Aditya Patkar Thuany Costa De Lima
Robert Hill Memorial Prize	Sheng Wang

Undergraduate	
Ken Campbell First Year Prize	Chung Hei Jonas Lai
Edward Irving Prize for Geophysics	Lachlan Anderson
W B Clarke Second Year Prize in Earth Sciences	Sebastian Bland
Irene Crespin Prize for Palaeontology	Moss Thompson
GSA Mike Rickard Third Year Prize	Lachlan Anderson
ANU University Medal	Jemima Jeffree

UNDERGRADUATE & POSTGRADUATE COURSES

Earth & Marine Science Programme

	Course Description	Convenor, Teaching staff	Number of students
EMSC1006/4006/6107	Blue Planet	M.Ellwood, N. Abram, E. Rohling, G. Falster	138
EMSC2022	Introduction to Global Geophysics	M. Miller, D. Heslop, V. Hui Lai, L. Moresi	29
EMSC2023	Fundamentals of Geology	G. Yaxley, A. Roberts	29
EMSC3020/4019/6019	Geobiology & Evolution of Life on Earth	J. Brocks, S. Kealy, S. Haberle	30
EMSC3023/6023	Marine Biogeochemistry	M. Ellwood	16
EMSC3024/4024/6024	Magmatism & Metamorphism	A. Berry, A. Burnham, G. Yaxley	14
EMSC3032/4032/6032	Melting Polar Ice Sheets	P. Tregoning	13
EMSC4017/8017	Research Methods and Proposal	A. Roberts	14
EMSC4033	Computational Geosciences: Problem-solving, Logical Thinking and Programming.	L. Moresi, N. Constantinou	14
EMSC4122/8022	Analytical Techniques	G. Yaxley	10
EMSC4123/8023	Data Analysis	M. Sambridge	3

Earth & Marine Science Programme

	Course Description	Convenor, Teaching staff	Number of students
EMSC4706/8706	Natural Hazards	P. Cummins	14
EMSC8032	Research Proposal & Presentation	D. Heslop	3
EMSC8034	Research Orientation: Big Questions in the Earth Sciences		0
Winter			
EMSC3019/6119	Coral Reef Field Studies	S.Fallon, M. Ellwood, G. Falster	20
Semester 2			
EMSC1008/6008	Earth	A. Berry, C. Eakin	69
EMSC2021/4021/6021	Climate System Science	C. Shakespeare	60
EMSC2024/6124	Geochemical Cycles	J. Brocks, M. Anenburg, D. Jacob, P. King	23
EMSC3002/4002/6030	Structural Geology & Tectonics	L. Moresi, C. Jiang	6
EMSC3007/6007	Economic Geology	J. Mavrogenes	15
EMSC3022/6022	Planetary Science	P. King, R. Kirby	44
EMSC3025/4025/6025	Groundwater	P. Tregoning	23
EMSC3027/4027/6027	Palaeoclimatology & Climate Change	E. Rohling, K. Grant J. Yu	20

Earth & Marine Science Programme

	Course description	Convenor, teaching staff	Number of students
EMSC4017/8017	Research Methods and Proposal	H. Tkalčić	8
EMSC3034/6034	Dynamic Earth	R. Davies	11
EMSC4033/8033	Computational Geosciences: Problem-solving, Logical Thinking and Programming.	L. Moresi	0
EMSC4123/8023	Data Analysis	M. Sambridge	9
EMSC8032	Research Proposal & Presentation	D. Heslop	8
EMSC8034	Research Orientation: Big Questions in the Earth Science		0
Spring			
EMSC3019/6119	Coral Reef Field Studies	S. Fallon, N. Abram, M. Ellwood	17
EMSC3050	NCP Field trip (Japan)	D. Heslop, W. Grant (CPAS), P. Hu	15
All Year			
EMSC3050/4050/6805/8014	Research project (6 units)	EMSC3050 EMSC8014	14 1

Credit: Alysha Jones, Guadalupe Alvarez, Shubham Agrawal

Physics Programme (Research School of Physics & Engineering)			
	Course description	Convenor, teaching staff	Number of students
PHYS2201	Classical Mechanics	A. Hogg	67
PHYS3070	Physics of the Earth	H.Tkalčić, L. Moresi	6
PHYS3202	Fluids & Plasma	K. Stewart	3
Biological Anthropology Programme (Research School of Humanities & the Arts, School of Archaeology and Anthropology)			
ARCH3042/6510	Scientific Dating in Archaeology & Palaeoenvironmental Studies	R. Wood, K. Grant, D. Heslop	19
Environmental Science Programme (Fenner School of Environment & Society)			
ENVS3013	Climate Change: Past, Present and Future	J. Gergis (Fenner), N. Abram	46

Credit: Timothy Leong (top), Brian Kennett (ower left), Rajesh Reddy (lower right)

CLIMATE & OCEAN GEOSCIENCE

Group leader Prof. Paul Tregoning (from 19/05/2022)
Prof. Andy Hogg (to 01/05/2022)

Academic members Prof. Nerilie Abram, Dr Sebastien Allgeyer, Prof. Leanne Armand, Dr Pamela Barrett, Dr Navid Constantinou, Prof. Stephen Eggins, Prof. Michael Ellwood, Prof. Stewart Fallon, Dr Katharine Grant, Emeritus Prof. Ross Griffiths, Dr David Heslop, Dr Wilma Huneke, Dr Andrew Kiss, Dr Jia Liu, Dr Simon McClusky, Dr Herb McQueen, Dr Adele Morrison, Dr Bradley Opdyke, Emeritus Prof. Brad Pillans, Dr Anthony Purcell, Dr. Mahdiyeh Razeghi, Prof. Andrew P Roberts, Prof. Eelco Rohling, Dr Callum Shakespeare, Dr Kial Stewart, Dr Rachel Wood, Dr Nicky Wright, Prof. Jimin Yu, Dr Xiang Zhao

Overview

Research in Climate and Ocean Geoscience (COG) at RSES focuses on ocean modelling, climate reconstructions, sea level rise and past and present changes in polar ice sheets, dust, deep-sea chemistry, atmospheric CO2 and satellite orbit modelling for Earth observations. Our research is as diverse and interdisciplinary as it is interesting, bringing together a wide range of expertise in both observational and numerical modelling to understand our Earth and how it is changing.

2022 was a successful year for COG with, among other things, the release of new ocean models (Figure 1) and estimates of mass transport across Earth. A number of papers were published on topics as wide-reaching as changes to the East Antarctic Ice Sheet, modelling of southern ocean eddies, time-varying changes in Earth's gravity field and fine magnetic particle assemblages.

Two very prestigious prizes were awarded to COG members during 2022: Dr Adele Morrison was awarded the Malcolm Macintosh prize for Physical Scientist of the Year and Prof. Andrew Roberts was awarded the Mawson Medal by the Australian Academy of Science. One PhD and two Honours students graduated during the year and there were two new academic appointments (Dr Holgate, Dr McGirr). Five projects were funded through competitive grant schemes, bringing valuable funding to COG for ongoing and new research programs.

Research Highlights

The Climate and Fluid Physics group published a significant body of work focused on understanding various aspects of ocean and atmosphere dynamics. Honours student Claire Yung led work showing that the Southern Ocean eddy-driven upwelling that closes the ocean's deep overturning circulation is localised in small number of discrete hotspots downstream of significant topographic features. PhD student Jemima Rama published two papers investigating the influence of wavelength and background ocean currents in controlling the propagation of near-inertial waves – a key dynamical process which is responsible for mixing heat and carbon into the deep ocean. Kial Stewart led work using a laboratory model of the Jet Stream to predict that climate change will cause a reduction in the blocking events which tend to drive clear and stable atmospheric conditions.

COG Continued

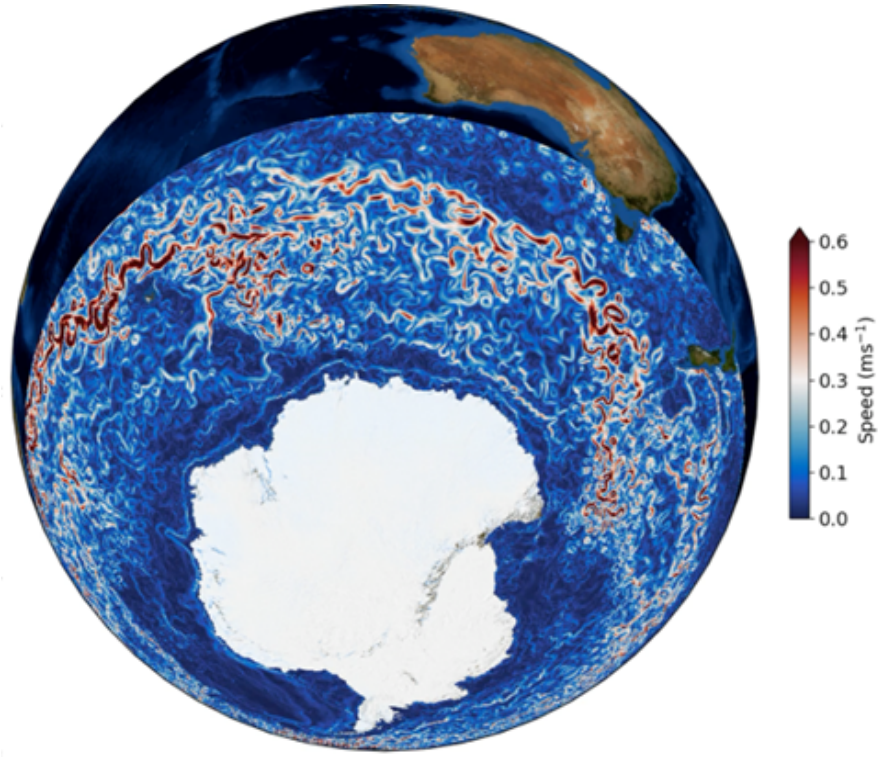


Figure 1: A new pan-Antarctic regional ocean model configuration developed in 2022 by members of the CFP group.

In addition to this new research, Adele Morrison led a review paper on "Ventilation of the Southern Ocean Pycnocline" in the high-profile Annual Reviews of Fluid Mechanics which unravels the complex pathways by which heat and carbon are absorbed in the Southern Ocean.

Nerilie Abram contributed to a major review of East Antarctic Ice Sheet change, published in the highly prestigious journal Nature. Nerilie also co-authored important research diagnosing the synoptic drivers of south-eastern Australia's 2019 'Black Summer' bushfires. Chiara Holgate led work describing the influence of remote climate drivers on moisture sources for rainfall over eastern Australia.

The Environmental Geodesy group published two companion papers in Journal of Geophysical Research, outlining their unique strategy for quantifying mass transport on Earth through an analysis of measurements from the GRACE space gravity mission. PhD student Rebecca McGirr led a study to investigate the impact of instrument noise and changing satellite altitude on the accuracy of estimates of Earth's gravity field derived from GRACE/GRACE Follow-On data. A new CRC project was established with company Q-CTRL to investigate how the use of satellite-based cold atom gravimetry might improve the estimation of mass anomalies on and within Earth. Funding was received from AuScope (through Geoscience Australia) to automate the analysis of the GRACE Follow-On instrument data and the products were made publicly available through the AuScope data portal.

The Paleomagnetism Research Group published papers on a diverse range of topics in 2022. This included publications in Nature Geoscience, Earth-Science Reviews and Reviews of Geophysics. The Paleomagnetism group published a review paper "Unlocking information about fine magnetic particle assemblages from first-order reversal curve diagrams: Recent advances", which brought together findings from an international project funded by the Japanese National Institute of Advanced Industrial Science and Technology and undertaken in collaboration with the Japanese Geological Survey, Imperial College London, and the University of Cambridge.

COG Continued

David Heslop co-authored a paper in International Statistical Review based on an ongoing collaboration with the ANU Research School of Finance, Actuarial Studies and Statistics on the development of inference techniques for directional data. ARC Discovery Project "Understanding the Geodynamo: Putting Australia on the Map" was commenced with collaborators from Scripps Institution of Oceanography, GFZ German Research Centre for Geosciences, and the University of Melbourne

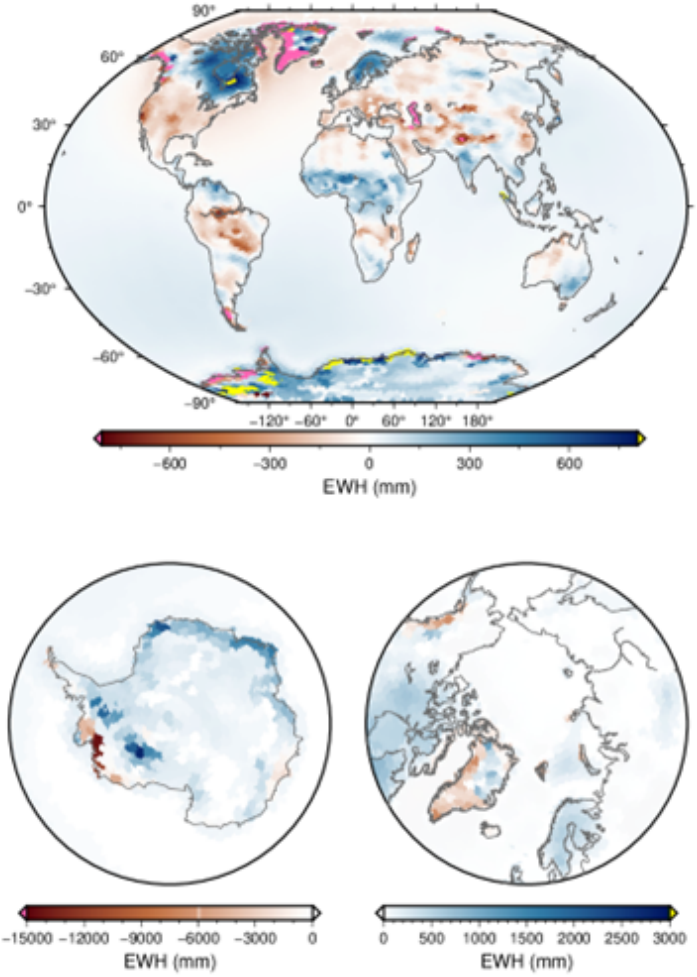


Figure 2. Changes in Earth's gravity field for November 2022, in terms of an equivalent height of water (in mm). Hydrological processes can be seen on continents and mass loss of polar ice sheets in Greenland and Antarctica

Staff News (including appointments, grants, awards etc)

Prizes

- Dr Adele Morrison was awarded the Malcolm Macintosh prize for Physical Scientist of the Year. This is one of the prestigious Prime Minister's prizes for science.
- Dr Navid Constantinou was awarded the Most selfless contributor award from the Consortium of Ocean and Sea Ice Modelling in Australia
- Professor Andrew Roberts was awarded the 2022 Mawson Medal and Lecture by the Australian Academy of Science.

Appointments

- Dr Chiara Holgate commenced a research position in February 2022 as part of the Centre of Excellence in Climate Extremes. Her research focuses on understanding the processes driving hydrological extremes.
- Dr Rebecca McGirr commenced a postdoctoral appointment through ACEAS funding to assess what spatial and temporal resolution of mass balance estimates can be achieved from analyses of space-geodetic satellite data.
- Dr David Heslop became a CI on the Australian Research Council Special Research Initiative, Australian Centre for Excellence in Antarctic Science (ACEAS).

COG Continued

Grants

- Navid Constantinou, Z. Qu, M. Hole, and O. Anzecot, ICEDS Seed Grant ($13,500): “AI generation of cyclone data via learned physical constraints”
- Shakespeare, Morrison, Hogg, Arbic, ARC Discovery Project DP230101836 ($340k) [https://dataportal.arc.gov.au/NCGP/Web/Grant/Grant/DP230101836]
- Shakespeare, C., Stewart, K., Moore, L., Kraitzman, N., Holgate, C., Rummery, A., Roderick, M., College of Science Research Pipeline Seed Funding, Collaborative Environmental Fluid Mechanics at ANU, AUD$37,406.
- Paul Tregoning, CRC-P project ($2.75M), led by Q-CTRL: “Integrating Quantum Tech into Space Manufacturing for Defence & Agriculture”
- Paul Tregoning, AuScope project ($192,000): “Automation of GRACE Follow-On Level-1B data processing”

Student News

- Kit Leong commenced her PhD (supervised by Paul Tregoning): “Joint inversion of space gravity and satellite altimetry data to improve spatial resolution of mass balance change estimates in Antarctica”

PhD awarded

- Rebecca McGirr was awarded her PhD (without modification) titled “Estimating Earth’s temporal gravity field from GRACE observations: Mitigation of thermal errors and the interplay between orbital characteristics, basis functions and spatial resolution.”

Honours completions

- Lachlan Dodd completed his honours project (supervised by Paul Tregoning) on analysing the final year of instrument data from the GRACE mission. His work led to several essential improvements to the ANU GRACE software.
- William Palm completed his honours (supervised by Kial Stewart) looking at sea ice growth in the laboratory.

Emeritus, Honorary Staff and Visitors

· Professor Michael Roderick remains an active Emeritus staff member in Climate and Fluid Physics.
· Professor Kurt Lambeck remains an active Emeritus staff member in Environmental Geodesy.

AUSTRALIAN & NEW ZEALAND INTERNATIONAL OCEAN DISCOVERY PROGRAM CONSORTIUM (ANZIC)

Group leader	Prof Leanne Armand (to 04/01/2022) Dr Ron Hackney (from 01/07/2022)
Program Manager	Dr Sarah Kachovich
Members	Kelly Kenney, Jenifer Waters

2022 was a year of significant challenge and adaptation at ANZIC, with major changes in leadership and considerable uncertainty around future funding. Despite this, it was also a year of much activity and growth, delivering opportunities for many Australian and New Zealand researchers to participate in the International Ocean Discovery Program (IODP) and considerable momentum in securing an expanded long-term future for ANZIC.

On 4 January, our community was saddened by the passing of Prof Leanne Armand, much-loved and respected ANZIC Director and researcher at RSES. Prof Armand had guided ANZIC with great distinction and in doing so had gained the affection and esteem of the entire global IODP community. Following a period of understaffing and after an extensive search, Dr Ron Hackney was appointed ANZIC Director commencing in July 2022, joining ANZIC Program Manager Dr Sarah Kachovich and supported by Administration Officer Kelly Kenney and Communications Officer Jenifer Waters.

With the existing two-year ARC-LIEF funding concluding in December 2022, there was a significant focus on securing a subsequent grant to ensure the next two years of operation. A new two-year ARC LIEF grant was awarded in November 2022. Alongside this, plans progressed on a partnership with AuScope under the National Collaborative Research Infrastructure Strategy for longer-term funding post-2024, expanding ANZIC's connection to this vital research community with the aim of enhancing access to subsurface sampling for research in our region.

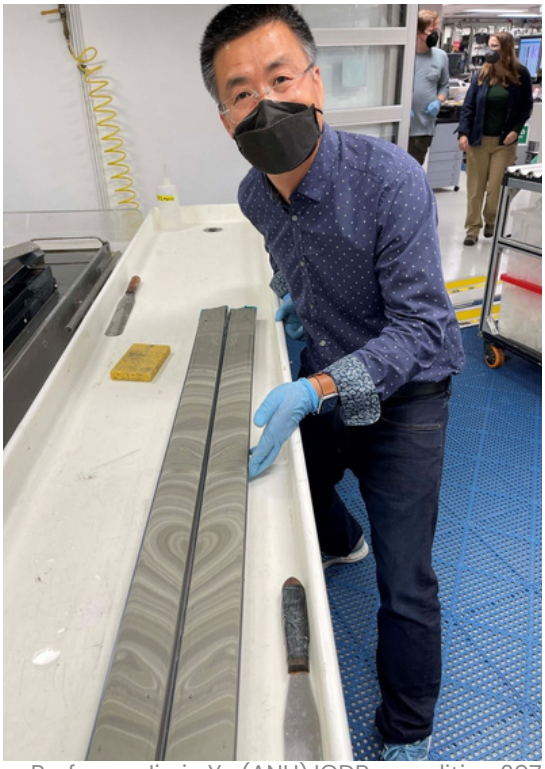
Throughout all this uncertainty and change, the ANZIC Office facilitated the participation of four researchers in IODP expeditions during 2022, including two from ANU:

- Dr Derya Gürer (ANU/UQ) – IODP Expedition 392: Agulhas Plateau Cretaceous Climate
- Professor Jimin Yu (ANU) – IODP Expedition 397: Iberian Margin Paleoclimate
- Professor Myra Keep (UWA) – IODP Expedition 386: Japan Trench Paleoseismology
- Acacia Clarke (UTAS) – IODP Expedition 398: Hellenic Arc Volcanic Field

IODP Continued

ANZIC member researchers in the program once again generated significant published works arising from IODP science, with a total of 134 publications for Australia and New Zealand authors in 2022. Overall, there were 2709 publications in IODP science from global scientists in 2022. Explore IODP's publication report in more detail here.

As travel began to resume post-COVID, the ANZIC Office embraced the opportunity to connect with our global colleagues in IODP and explore strategic collaborations with other programs including the International Continental Scientific Drilling Program (ICDP) Dr Hackney travelled to Japan, the United States, and Europe, participating in meetings with our counterparts in IODP, the European Consortium for Ocean Research Drilling (ECORD), the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), and ICDP. Dr Kachovich also travelled to Vienna and Washington for IODP events and attended AGU2022 in Chicago.



Professor Jimin Yu (ANU) IODP expedition 397

ANZIC also maintained a high level of activity engaging our community with IODP science, with the ANZIC Forum in April a key highlight. Hosted at ANU, the two-day hybrid event brought together 154 members of the scientific ocean drilling community for critical exchange of information and ideas on Australia and New Zealand's participation in IODP.

The ANZIC Office conducted significant outreach activities during the year, including presenting at CONASTA '69 conference and delivering workshops to a variety of visiting school and university groups. Our external profile was also given a significant boost by the announcement of Dr Sarah Kachovich as one of the latest cohort of Science & Technology Australia's Superstars of STEM. During the year she also served on STA's Board of Directors as representative for Geography/Geology, and was among three ANZIC representatives – joined by Dr Chris Pigram (ANZIC Governing Council Chair) and Carmen Gaina (Queensland University of Technology Chief Investigator) – to participate in STA's Science Meets Parliament program.

Engaging the next generation of marine geoscientists in scientific ocean drilling is a significant priority for ANZIC. The annual ANZIC Masterclass was held in December, with 16 students from across Australia and New Zealand – including Moss Thompson from ANU – taking part in a vibrant program of workshops and field trips in Sydney and on the NSW South Coast. ANZIC also facilitated the participation in ECORD Summer Schools of several students including ANU's Victor Piedrahita Velez and Imogen McDermott, with RSES PhD candidate Udara Amarathunga also attending through his connection with ANZIC-IODP

The ANZIC Office at RSES hosted several visitors during 2022 including Dr Chris Pigram AM, Dr Carmine Wainman (Geoscience Australia), Dr John Dodson (ICDP), Dr Tim Rawling (AuScope), and Phil Boxall (Australian Antarctic Division). Quarterly meetings of the ANZIC Governing Council and ANZIC Science Committee were also held onsite.

As plans progress to secure longer term funding and enhance the scope of the program to encompass land to sea drilling, ANZIC is excited by and optimistic for the future of scientific drilling in our region and energised by a vibrant and motivated community committed to advancing a new frontier in geoscience research.

GEOCHEMISTRY

Group leader Prof. Greg Yaxley

Academic Members Assoc. Prof. Yuri Amelin, Dr Michael Anenburg, Emeritus Prof. Richard Arculus, Prof. Vickie C. Bennett, Prof. Andrew Berry, Prof. Jochen J. Brocks, Dr Antony Burnham, Emeritus Prof. Ian Campbell, Dr Marnie Forster, Prof. David Green, Dr Masahiko Honda, Prof. Trevor Ireland, Prof. Dorrit Jacob, Prof. Penelope King, Prof. John Mavrogenes, Dr Seann McKibbin, Dr Laura M. Otter, Dr Zachary Sudholz, Dr Lennart van Maldegem, Emeritus Prof. Ian Williams, Emeritus Prof. Lesley Wyborn

Overview

The Geochemistry Research Area includes a diverse collection of research groups including:

- Experimental Petrology
- Argon Geochronology, Structural Geology & Tectonics
- Earth Systems Chemistry
- Jacob Group
- Brocks Geobiology

During 2022, our major strategic goals centered around:

1. Continuing to support and grow major high-quality, strategic programs of research with societal benefits, including critical metals and greenhouse gas sequestration, aiming to position RSES and ANU as Australia's leading research institute in these areas.
2. Undertaking innovative curiosity-driven research on Earth geochemical processes over time including the evolution of its geology, hydrosphere, atmosphere and biosphere.
3. Growing our staffing and HDR student critical mass to achieve research goals and increase collaboration and collegiality in the research area.

We made considerable progress in all of these areas, and a summary of some of our achievements during 2022 is presented below.

Research Highlights

Research highlights in the Experimental Petrology Group included a paper in Nature Communications entitled "Fractional crystallisation of eclogite during the birth of a Hawaiian Volcano" by Laura Miller and Andrew Berry and a paper in Contributions to Mineralogy and Petrology entitled "A new model for zircon saturation in silicate melts" by Laura Crisp and Andrew Berry.

PhD student Catherine Wilsbacher and Andrew Berry were awarded synchrotron beamtime at the Advanced Photon Source (APS) in Chicago to investigate the speciation of rare earth elements in carbonatites. Catherine's trip to Chicago was partly funded by a grant from the ANSTO International Synchrotron Access Program. Andrew Berry also participated in an experiment at the APS on the redox state of Fe in arc magmas in collaboration with Olivier Alard of Macquarie University (who joined the Geochemistry Group in 2023). Laura Miller used the Australian Synchrotron to investigate the structure of novel bismuth-platinum oxides, which were synthesised at high pressure in the Experimental Petrology laboratory.

Geochemistry Cont.

Andrew Berry and ANU have filed a patent on a new process for recovering rare earth elements from phosphate ores.

Greg Yaxley and Andrew Berry received seed funding from the ANU College of Science, which was used to employ two postdoctoral research assistants (Laura Crisp and Gopalakrishnan Kothandam), to explore using high-pressure to synthesise new battery materials. The project was in collaboration with RSC and has also facilitated collaborations with UNSW and USyd.

The Argon Geochronology Group continued their participation in the MinEx CRC "National Drilling Initiative" in their Phase 2 Program and workshops and completed the AuScope supported "The National Argon Map".

A research highlight in the Earth Systems Geochemistry Group was involvement in analysing samples returned from Hayabusa 2 mission to Ryuguin in the SHRIMP laboratory.

Profs Penny King (lead), D Jacob, J Mavrogenes, I Williams, R Wood & 7 others (Geoscience Australia, CSIRO, Macquarie Univ., Griffith Univ.), were awarded $345k from the Australian Research Council, Large Infrastructure & Equipment Fund for a project entitled "Integrated volatile-mineral-isotope micro-analysis of Earth environments."

Highlights from Dorrit Jacob's research group included an article published in Geology that rounded off a series of articles on diffusion models on protogenetic diamond inclusions. These articles establish the important framework for reliable dating of diamonds using their inclusions.
Work on the structure of amorphous calcium carbonate in the laboratory and in natural systems continued to make waves with a much-noticed article in Scientific Reports.

The Brocks Geobiology Group issued a press release about the discovery of molecular remains of the last meal of the Ediacaran organism Kimberella, one of the first animals in the geological record. The molecules revealed that Kimberella was feeding on green algae in microbial mats and that it already possessed a gut. The story was reported in the news world-wide, achieving an AltMetric score of 645. The 2022 Bear McPhail Excellence in Teaching Award went to convenor Jochen Brocks and demonstrator PhD student Caleb Bishop for EMSC3020 (Geobiology).

Labs & facilities news

Renewal and reorganisation of the SHRIMP labs continued through 2022. A number of new SHRIMP techniques were developed and calibrated including F, C and H in glasses, O-isotopes in aragonite and 3-S-isotopes in sulfates (ongoing) and 2-S isotopes in basaltic glasses and Mg isotopes (olivine and dolomite). On SHRIMP-II, a new multi-detector set up for analyses of three isotopes with iFlex detectors was successfully implemented.

The School invested in a phase analytical facility by purchase of a Photo-Induced Force Microscopy System, the first of its kind in Australia. The instrument uses lasers and Atomic Force Microscopy to analyse infrared spectra in situ at nanometer resolution.

In the Infrared Laboratory, the video camera was replaced and the Ge-tipped ATR was replaced twice. The Environmental Chamber was set up again and more detailed instructions were created. The instructions were completely revamped for all types of IR analysis. The lab was moved to the Florey Building.

Geochemistry Cont.

Staff news

Andrew Berry was an invited speaker at the 18th International Conference on X-Ray Absorption Fine Structure in Sydney in July and at an international school on "Understanding Oxygen Fugacity in Geoscience" held in Trieste in September.

Greg Yaxley participated in the organisation of the oxygen fugacity school in Trieste and presented a talk there.

Andrew Berry continued to serve on the Beamline Advisory Panel of the Medium Energy XAS (MEX) beamline of the Australian Synchrotron and on the ANU Major Equipment Committee.

In sad news, Bill Hibberson, who provided technical support to the experimental petrology group for several decades, passed away in April. His funeral was very well attended by past and present members of RSES.

Dr Marnie Forster, leader of the Ar Geochronology Group, was an invited Speaker at the MinEx CRC Annual Conference 2022 and gave a talk entitled “Inferring characteristics of a cryptic history of fluid-alteration/metasomatism and temperature-time variation using a collection of argon age spectra measured from drill core from the TISA East Tennant Project in the National Drilling Initiative”. She also attended the Argon Geochronology Workshop at MinEx CRC Annual Conference 2022 “Getting the most out of your date: 40Ar/30Ar geochronology@ANU”

In the SHRIMP labs Emeritus Prof Ian Williams generously continued in his role as lab manager. From Feb 2022, Ms Sonja Zink was redeployed by RSES as technical support and replaced by new staff-member, Dr Monika Misztela who left after 5 months. Dr Bei Chen started in June 2022. Dr Yue Wang was hired in July 2022 to help with setting up the SHRIMP-II multi-collector for new light isotopes. Prof Penny King contributed funding and administrative activities to the SHRIMP laboratory.

Operations in the IR and synthesis labs continued with Mr Caleb McCollum hired in Dec 2022 as a casual student to help in the laboratory. Prof Penny King had oversight of funding, training, maintenance and administrative activities in the IR laboratory.

Jochen Brocks was awarded The Australian Organic Geochemistry Medal, for major achievements and contributions to the field.

Student news

Amelia Lewis and Lauren Schenk completed honours projects supervised by Prof Greg Yaxley. Amelia investigated new approaches to the extraction of rare earth elements from the mineral allanite, and Lauren conducted an experimental project aimed at calibrating the partitioning of rare earth elements between upper mantle minerals as a function of temperature and composition.

Zach Sudholz (supervisors Prof Greg Yaxley and Dr Lynton Jaques) was awarded his PhD titled “Geothermobarometry of garnet-bearing peridotites, pyroxenites and eclogites and a mantle view of the South Australian Craton and Phanerozoic Tasmanides of eastern Australia: Petrological constraints on lithospheric architecture, mantle lithology and geochemistry”. Zach then commenced a post-doctoral fellowship funded by Geoscience Australia in the Experimental Petrology Group.

A New MPhil candidate, Ms. Yunqi Wu (Yoli), a MinEx CRC supported student, commenced her research in the Ar Geochronology Group. Her project is partially supported by the Geological Survey of Western Australia, and is titled “Application of argon geochronology to constrain shear zone movement and exhumation of the northern and eastern margins of the West Australian Craton”.

Geochemistry Cont.

Ana Casas Ramos, 3 others M. Taheri (lead), were awarded $20k funding from ICEDS Seed Funds for a project to develop the utilisation of solar-thermal energy for carbon sequestration.

Aditya Patkar and Rachel Kirby received the Mervyn and Katalin Paterson Fellowship.

Rachel Kirby was awarded a grant from ANSTO to attend the Australian Synchrotron for 96 hours of XFM beamtime

Julia Brand (supervised by Prof Penny King) work on the use of femtosecond pulsed lasers for removing graffiti was featured in News and Views editorial in Nature Photonics.

Hannah Loiterton completed her Honours degree on “Calcium Oxalate Coatings and the Search for Life on Mars”

PhD candidate Tharika Liyanage was awarded the Robert Hill Memorial Prize.

Emerititus, Honorary Staff and Visitors

The Experimental Petrology Group was visited by Prof Jon Blundy (University of Cambridge). The group benefited greatly from the valuable contributions of Richard Arculus (Emeritus), Lynton Jaques and Terry Mernagh (Honorary staff members) and Andrea Gerson (Adjunct Prof.)

The Structure and Tectonics and Argon Geochronology Team was visited by Professor Suzanne Baldwin. Suzanne is the Director of the Argon Facility at the Syracuse University, New York, US.

Dr George Gibson, one of our visiting and honorary associates, organized and led two excursions: one undertaken in May for predominantly industry participants but which also included ANU staff and students, and the other for representatives from USGS, Geological Survey of Canada and Geoscience Australia making up the International Critical Metals Mapping Initiative.

Tony Eggleton continued work on stilpnomelane.

Manuel Rigo (Associate Professor, University of Padova) visited the SHRIMP lab for analyzing oxygen isotopes on conodonts.

Andrew Tomkins (Professor, Monash University) visited the SHRIMP lab for analyzing 4 sulfur isotopes on pyrrhotite and pyrite.

Credit: Shubham Agrawal

GEOPHYSICS

Group leader Prof. Hrvoje Tkalčić

Academic Members Prof. Steve Cox, Prof. Phil Cummins, Prof. Rhodri Davies, Dr Caroline M. Eakin, Dr Sia Ghelichkhan, Dr Babak Hejrani, Dr Mark Hoggard, Prof. Ian Jackson, Dr Chengxin Jiang, Dr Voon Hui Lai, Dr Xiaolong Ma, Prof. Meghan S. Miller, Prof. Louis Moresi, Dr Thanh-Son Pham, Dr Robert Pickle, Prof. Malcolm Sambridge

Overview

This year alone, research in the Geophysics Area spanned Earth's interior from the innermost inner core to the crust, earthquake sources, hazards, mapping shear zones, heterogeneity and anisotropy, observational and theoretical seismology, arrays, OBS- and DAS-related topics, AI, geophysical inference, geodynamical modelling, volcanoes, oceans, cryosphere, and we even reached out to the Red Planet. We published between 40 and 50 papers with exciting discoveries and advances and attracted considerable investment.

Forty seismometers from the Lake Eyre Basin Seismic Array were retrieved in June completing the data collection, almost 4 years since the first instrument was installed. Work is ongoing to study the seismicity, crustal and lithospheric structure beneath this region.

A successful DAS (distributed acoustic sensing) deployment in urban Melbourne took place in collaboration with InPAC lab at RMIT.

The ARC LIEF deployment in Antarctica near the Casey station — a collaborative project with UTAS (UTAS CI Anya Reading / ANU CI Tkalčić) — started with a spiral arm array deployment.

Research Highlights

In Caroline Eakin's research group, the first paper from the Lake Eyre Basin project was published in GJI led by PhD student Shubham Agrawal, which characterised the sediment thickness across South Australia using a novel approach that utilised delayed arrival times in receiver functions. This work is to be expanded across the Australian continent in a newly funded project with Geoscience Australia, with additional support received from the RSES Director's Award for Strategic Research.

In Louis Moresi's group an earthquake rupture modelling workflow was developed that integrates into the tectonic deformation code Underworld. This allows to study timescales from seconds to tens of thousands of years and understand coupling between surface deformation, earthquake rupture dynamics, and non-linear deformation in the lithosphere. The group re-engineered the computational engine behind Underworld to improve parallel scaling to 10000+ cores in order to be in a position to run these coupled models.

Geophysics Cont.

In Malcolm Sambridge's group the first major project on applying optimal transport principles to seismic waveform inversion was completed. This involved collaborators from several institutions in Europe in a joint effort to advance our understanding and capability in earthquake source and lithospheric imaging studies. The group entered into a partnership with CSIRO and AuScope Ltd, to develop a new example driven geoscience software platform for sharing and solving inversion problems. This is the start of an 5 year open source project which will act as a community collaboration vehicle for advancing methods and the practice of geoscience data analysis. The group also maintained and extended 'The Australian seismometers in Schools' network to 50 high schools across Australia.

In Meghan Miller's research group, they have successfully initiated the establishment of Distributed Acoustic Sensing (DAS) and further expanded large-N techniques and instrumentation with funding from AuScope and the ARC for observational seismology in Australia. Voon Hui Lai and Meghan Miller completed a 3-month DAS experiment in Melbourne in collaboration with RMIT recording both anthropogenic signals and earthquakes to image shallow velocity structures, important for seismic hazards. The group is also actively involved in establishing DAS metadata standards with the global DAS community (led by Voon Hui Lai) and the ARDC funded Geophysics 2030 project. Her group continues to work on field-based studies of subduction zones (Alaska, Indonesia, Cascadia) and continental lithospheric structures with a series of high-impact papers led by herself, recent PhD student graduate Ping Zhang and Research Fellow Chengxin Jiang.

In Rhodri Davies' research group, research led by PhD student Fangqin Chen has shown how the dynamics of subduction are influence by our planet's sphericity. Research led by former PhD student (now post-doc) Thomas Duvernay has transformed our understanding of the dynamical mechanisms underpinning intra-plate volcanism, which has particular relevance within Australia. The first paper on the cross-NCRIS (ARDC, AuScope, NCI) Geodynamic Adjoint Inversion Platform (G-ADOPT) appeared as a Highlight paper in Geoscientific Model Development. By reconciling seemingly disparate datasets for the first time, a collaborative study, involving Mark Hoggard and Sia Ghelichkhan on deep mantle structure demonstrated that, although LLVPs are dominantly thermal structures, their basal sections likely represent a primitive chemical reservoir that is periodically tapped by upwelling mantle plumes. Finally, Rhodri, Sia and Mark published a solicited book chapter on the current status and future directions of research into Earth's dynamic topography."

In Hrvoje Tkalčić's group, the year started with a paper in Nature Geoscience on the nature of the ultra-low velocity zones in the lowermost mantle. The work was led by his former PhD student Surya Pachhai (started as the last chapter of his PhD thesis). In a paper on marsquakes published in Nature Communications, Sun and Tkalčić reported the discovery of 47 repetitive marsquakes in Mars' mantle. PhD student Thuany Costa de Lima led a paper in JGR on the anisotropy structure of the innermost inner core. A former Honours student Jack Muir led research on the topography at the core-mantle boundary, published in GRL. Postdoc Xiaolong Ma led research on the outer core's structure, published in PEPI. PhD student Sheng Wang led research on scanning the Mars' core using innovative interferometry methods, published in Nature Astronomy. Hrvoje Tkalčić summarised the 2022 highlights in Geo Down Under: https://www.geo-down-under.org.au/2022-in-a-nutshell/

In Phil Cummins' group, an analysis of historical accounts of 1200 Indonesian earthquakes during the years 1546-1950 was completed, that includes the development of the largest database of uniformly assessed macroseismic intensities ever assembled for Indonesia.

The analysis documents ground motions that in some locations greatly exceeded those of instrumentally recorded events over the past 100 years. This new work should lead to a reassessment of seismic hazard in some of Indonesia's major urban centres. The results of the study are published as Martin et al. (2022) in BSSA.

Geophysics Cont.

Chengxin Jiang (DECRA Fellow) was involved in a recent Science paper on advanced seismic imaging technique to map the location and amount of melt under the Yellowstone supervolcano. It was found that the largest amount of melt is roughly in the depth range where previous eruptions were sourced. However, the amount of melt is much lower than required for a massive eruption anytime in the near future. The related stories were reported by many media outlets such as phys.org, NewScientist and NewYorkTimes.

Mark Hoggard (DECRA Fellow) conducted research on the impact of 3D mantle structure on glacial isostatic adjustment in the Red Sea, the stability of pre-industrial sea level, the impact of lateral mantle structure on estimated ice volumes during the Last Glacial Maximum, links between craton boundaries and the distribution of world-class lead-zinc deposits, and the thermochemical nature of LLSVPs.

Brian Kennett (Emeritus Professor) has led a community effort to produce an updated map of the depth to Moho Australia incorporating over 4300 localised estimates, more than three times as many as in the last fully published version in 2013. The resulting paper, with 13 co-authors will appear in Geophysical Journal International in 2023. He has also continued studies of various aspects of wave propagation including multi-mode surface waves and P modes excited by the landing of an aircraft on the Greenland Ice cap (with Andreas Fichtner, ETH, Zurich) and ground motion anomalies in Japan from Ryukyu earthquakes (with T. Furumura, ERI, Tokyo).

Ian Jackson and his PhD student Tongzhang Qu have revisited the problem of the grain-size sensitivity of viscoelastic relaxation in synthetic dunites with improved experimental methods. With markedly stronger grain-size sensitivity than previously observed, extrapolation to upper-mantle conditions suggests that such grain-size sensitive sub-solidus relaxation in pure, dry, melt-free dunite can account for no more than a 2% reduction of shear modulus with associated dissipation $Q^{-1} < 0.01$. Other factors including grain-boundary trace element impurities, more oxidising/hydrous conditions, dislocation damping, and partial melting are therefore required to explain stronger reductions of modulus /wavespeed and attenuation observed beneath young oceanic lithosphere and in subduction zones.

Stephen Cox has focused on developing relationships between cumulative moment release and injected fluid volume for deep injection experiments into low permeability crystalline rocks. This involved critical examination of seismicity catalogues for injection experiments in Australia, Basel, Soultz sous Forets, and Finland. He worked with Honours student, Chini Datta, on the Murrumbidgee Shear Zone. They mapped large parts of the shear zone, characterised its internal structures, determined its kinematics and deformation processes, and also used U-Pb geochronology of syn-deformation epidote to constrain its age.

Laboratories and Facilities

In 2022, we expanded our storage space in J6. Last year we received delivery of two new Abalones ocean bottom seismometers from Nanometrics. These have a low-profile design to reduce ocean floor noise and can operate from near-surface to 6000 m water depth.

We are running 50 real time instruments in the AuSIS array and provide outreach visits and incursions as part of the program.

Geophysics Cont.

The ANSIR facility provides more than 800 instruments for research use in Australia and New Zealand. We continue to upgrade and expand out instrumentation pool. In 2022 the ANSIR facility has supported:

Meghan Miller was one of the CIs that won an ARC Centre of Excellence as one of CIs on the project on Optical Microcombs for Breakthrough Science (COMBS) that will bring in 3 postdoctoral fellows and 2 PhD students to RSES.

Meghan Miller and Voon Hui Lai were awarded ARC Discovery Project on "Measuring the seismic pulse of the Earth using fibre optics" that will fund one postdoc and one PhD student.

Rhodri Davies and Malcolm Sambridge won an ARC Discovery Project on the spatial and temporal evolution of dynamic topography. Postdoc Sia Ghelichkhan will work on this for the next 3 years.

Thanh-Son Pham won a DECRA Project on probing Antarctic ice sheet by correlation seismology. A PhD student will join the project in 2023.

Deaths

Sadly, we lost Ted Lilley. All are encouraged to read more about Ted's life on the following websites: https://www.mtnet.info/memoriam/lilley.html and http://rses.anu.edu.au/~ted/

Student News

PhD completion

- Thomas Duvernay (Chair supervisor: Rhodri Davies)
- Ping Zhang (Chair supervisor: Meghan Miller)
- Tongzhang Qu (Chair supervisor: Ian Jackson)
- Sheng Wang (Chair supervisor: Hrvoje Tkalčić)

Submitted

- Fangqin Chen (Chair supervisor: Rhodri Davies)

Honours completion

- Edgar Leong (Chair supervisor: Mark Hoggard)
- Ruby Turner (Chair supervisors: Sia Ghelichkhan & Rhodri Davies)

Student Awards

- Edgar Leong: University Research Scholarship from the ANU College of Science to undertake his PhD
- Sheng Wang: Extraordinary Potential Prize - Chinese Government Award for Outstanding Students Abroad
- Sheng Wang: IUGG-SEDI Meeting Travel Grant, Zürich
- Sheng Wang: Selected Recipient for Camp for Applied Geophysics Excellence – ASEG
- Sheng Wang: AGU's Editor-highlighted paper "Shear-Wave Anisotropy in the Earth's Inner Core" in GRL
- Thuany Patricia Costa de Lima: RSES Mervyn and Katalin Paterson Fellowship

Geophysics Cont.

Emeritus, Honorary staff and Visitors

Emeritus Professor Ian Jackson was appointed Chair of the National Committee for Earth Sciences and continued to serve on the Sectional Committee 4 (Earth Sciences) of the Australian Academy of Science, and continued on the editorial boards of Earth and Planetary Science Letters, and Physics of the Earth and Planetary Interiors.

Mr. Xiaozhou Yang is visiting Dr. Chengxin Jiang and Prof. Meghan Miller at RSES for one year starting in May 2022. Xiaozhou's research topic is on improving the crustal and upper mantle seismic structures of the Southeast Tibetan Plateau through joint inversion of surface wave and body wave data.

In December, we had a two-week visit from Dr Fred Richards, who is a renowned geodynamicist and lecturer at Imperial College London.

Other news

Chengxin Jiang started his DECRA project in late March of 2022 on groundwater monitoring of the Great Artesian Basin in the NE Australia. Two students will join in this project in the first semester of 2023, including a master student Mr. Rakshith Ravichander and a PhD student Mr. Phudit Sombutsirinun.

Chengxin Jiang was selected as one of the AGU's outstanding reviewers for 2021 (JGR-Solid Earth)

Mark Hoggard started his DECRA project. PhD student Edgar Leong will join the project in 2023.

Meghan Miller begun her ARC Future Fellowship on Lighting up Dark Fibre for DASeismic imaging. New PhD student, Miracle Egbo, joined the project in late 2022 and postdoc Voon Hui Lai will work on this project for the next 3 years.

Mark Hoggard and Sia Ghelichkhan started a collaboration with Geoscience Australia to provide state-of-the-art sea-level forecasts for the coming century (Title: Next generation sea-level modelling), Mark Hoggard started a collaboration with Oxford University and the Exploring for the Future program to develop tools for better constraining crustal structure from seismic velocities and to investigate the crustal setting of copper porphyries (Title: Crustal architecture and metallogenesis). Rhodri Davies, Mark Hoggard and Sia Ghelichkhan joined the Australian Centre of Excellence for Antarctic Science, leading a project to quantify how Earth's surface and global sea level responds to melting polar ice sheets.

Rhys Hawkins started his Jubilee Joint Fellow project.

Hrvoje Tkalčić published a popular science book 'Earthquakes: Giants that sometimes wake up' (ISBN: 978-953-355-597-3) originally published in Croatian language and accompanied by interviews for TV, radio and newspaper articles. The book was selected by the Ministry of Culture to represent Croatian non-fiction books at the Frankfurter Buchmesse, the most significant annual book fair in Europe.

The first G-ADOPT workshop at RSES was held, which helped the G-ADOPT team (funded by a large cross-NCRIS project) to showcase progress on the forward modelling component of our platform. This was attended by ~30 people, from academia, government and industry.

The InLab Geophysics workshop was held, with support from AuScope and the CSIRO's Deep Earth Imaging Future Science Platform.

LABORATORY OPERATIONS GROUP

Group leader Brett Knowles

Academic Members Sonja Zink, Bin Fu, Janet Hope, Davood Vasegh, Laura Rodriguez Sanz, Ulrike Troitzsch, Ting Cheng, Xuan Ji, Monika Misztela, Bei Chen, Yue Wang, Wei Xiao, Yang Wu, Robin Grün, Joseph Cali.

Overview

The Geochemical Instrument Operations Team provides technical support to research and teaching activities within RSES through management and operation of core research & analytical facilities within the School. The laboratories managed by the team include thermal ionisation mass spectrometry (TIMS), trace wet chemistry, gas chromatography mass spectrometry (GCMS), sensitive high resolution ion microprobe (SHRIMP), laser ablation inductively-coupled mass spectrometry (LA-ICPMS), stable isotope mass spectrometry, argon geochronology, x-ray diffractometry (XRD), x-ray fluorescence (XRF), scanning electron microscopy (SEM), and photo-induced force microscopy (PiFM).

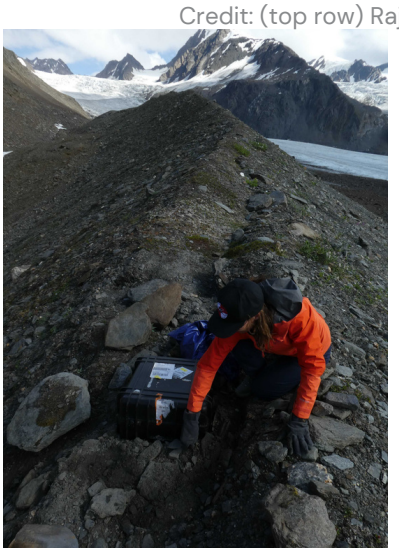
The new mineralogical and spectroscopy facility took shape in the Jaeger 3 building. Our new PiFM saw a range of novel research undertaken, with analytical findings presented at the 2022 Goldschmidt conference. A new Malvern Panalytical Aeris benchtop x-ray diffractometer was installed, expanding the analytical capacity and usability of the facility. We also took delivery of an Olympus Vanta M portable x-ray fluorescence spectrometer, enabling rapid and portable elemental analysis of samples in the lab or in the field. In addition, we have taken delivery of a Hitachi TM4000II desktop SEM with EDS, enabling low-vacuum imaging and analysis of a range of samples. Finally, we have ordered a Horiba LabRAM Soleil confocal Raman microscope, due to be delivered in Q1 2023. These instruments complement the Empyrean S3 x-ray diffractometer to complete our mineralogical and spectroscopy facility, under the expert guidance of our lab management staff.

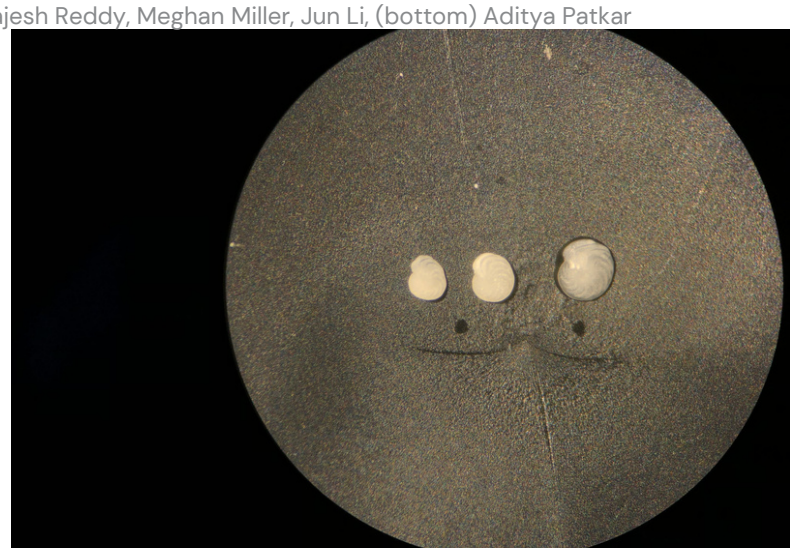
The year saw a lot of new faces joining the team, with the departure of some familiar faces. Ulrike Troitzsch left our team in January to take a secondment in the Research School of Physics. Wei (Vivian) Xiao and Yang Wu joined the team in July and August to manage the Jaeger 3 Spectroscopy Facility in the absence of Ulrike, and both bring a wealth of experience. Ting Cheng and Monika Misztela were farewelled from RSES in June as they moved on to new endeavours interstate and overseas. Support of the Boron clean laboratory was taken over by Xuan Ji in June, and Robin Grün joined the team in August as support staff for the Jaeger 7 ICP-MS Facility. We welcomed back a familiar face in Joe Cali in September, who is interim managing the stable isotope facility while Laura Rodriguez Sanz takes maternity leave. Bei Chen and Yue Wang both joined the team in July to manage the SHRIMP facility under Ian Williams' guidance, contribute to AuScope, and undertake method development. With the help of Ian Williams and the RSES Electronics Team, Bei & Yue were able to install and make operational a new SHRIMP multi-collector, opening up more B, Li, Be, Ca, Mg, Si, and K isotopic work.

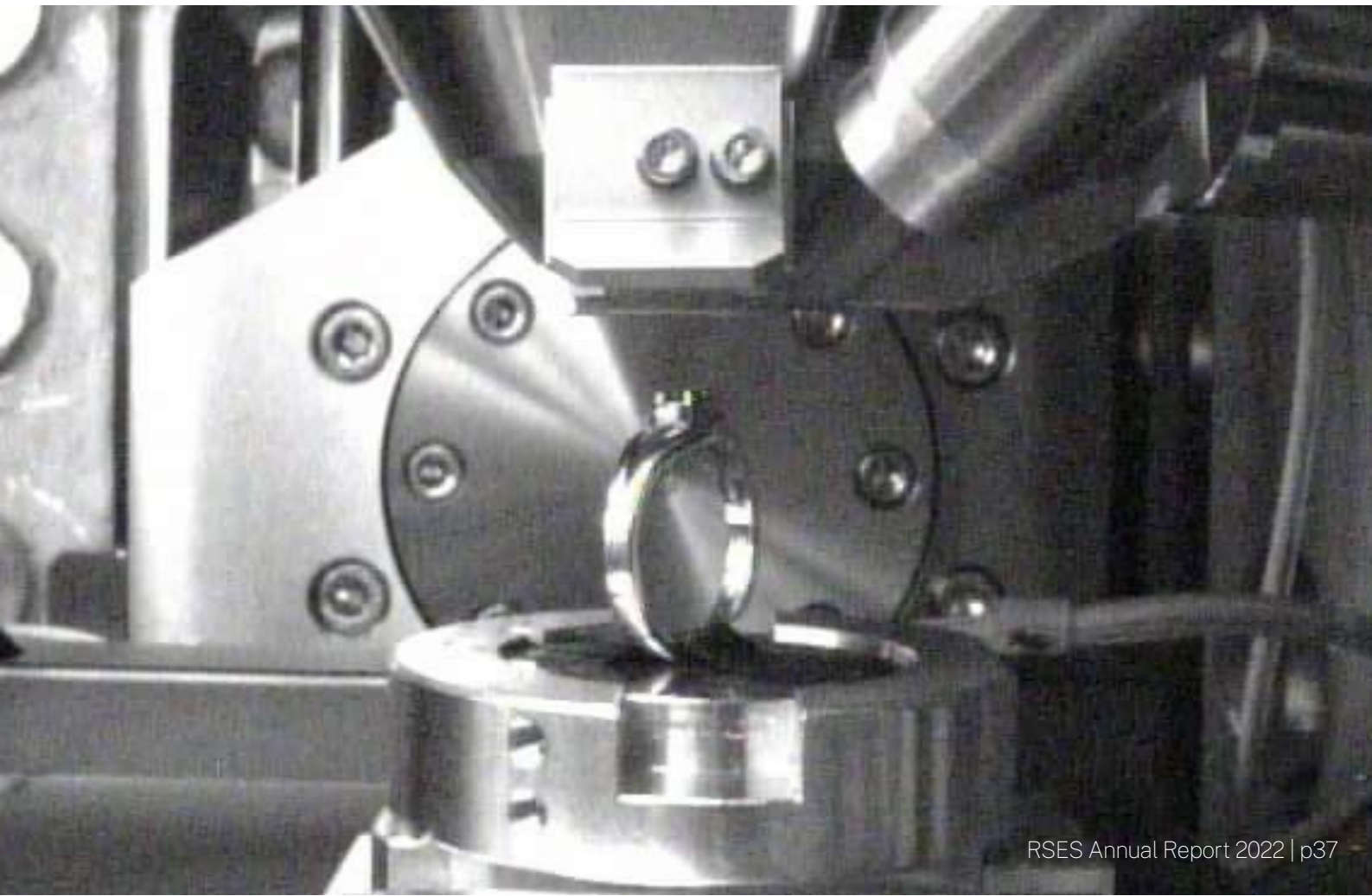
Laboratory Operations Group Cont.

A major equipment committee (MEC) grant bid was put forward by the team to replace the Lambda Physik LPFPro202 193 nm ArF excimer laser in the Jaeger 7 ICPMS Facility, to help future-proof the laser ablation capabilities of the School. The LPFPro202 has been a mainstay of the School's laser ablation capabilities for well over a decade, and thanks to this successful MEC grant bid this core research capability can be maintained in to the future. Team staff were also successful in professional staff professional development fund applications, with Sonja Zink representing the School at the triennial International Association of Geoanalysts Geoanalysis 2022 conference in Freiberg, Germany. Here Sonja presented newly developed analytical methods for ultraprecise measurements of extinct nuclide isotopic compositions (neodymium-142).

Credit: (top row) Rajesh Reddy, Meghan Miller, Jun Li, (bottom) Aditya Patkar







RESEARCH GRANTS AWARDED DURING 2022

Project/Grant Title	Administering Area	Lead CI	Awarded Date	Primary Funds Provider
Scoping study of garnet as a regional prospectivity tool	Geochemistry	John Mavrogenes	25/03/2022	Department of Natural Resources, Mines and Energy
Eastman Utramafic Intrusion in the Eastern Kimberley	Geochemistry	Michael Anenburg	26/05/2022	Peako Limited
Trace element and isotopic signatures of the IOCG deposits of North Queensland	Geochemistry	John Mavrogenes	5/08/2022	Department of Natural Resources, Mines and Energy
ANU Futures 2022	Geochemistry	Olivier Alard	6/12/2022	Australian National University (ANU)
The speciation of REE in carbonatites	Geochemistry	Andrew Berry	14/12/2022	ANSTO Australian Synchrotron
Sedimentary thickness across Australia from passive seismic methods	Geophysics - Seismology & Math Geophysics	Caroline Eakin	1/04/2022	Geoscience Australia
ARC Centre of Excellence in Optical Microcombs for Breakthrough Science	Geophysics	Meghan Miller	4/11/2022	Australian Research Council (ARC)
Probing Antarctic Ice Sheet by Correlation Seismology	Geophysics	Son Pham	16/09/2022	Australian Research Council (ARC)
Next generation sea-level modelling	Geophysics	Mark Hoggard	1/02/2022	Geoscience Australia
Measuring the seismic pulse of the Earth using fibre optics	Geophysics	Meghan Miller	24/11/2022	Australian Research Council (ARC)
ARC Centre of Excellence for The Weather of the 21st Century	Ocean & Climate Geoscience	Nerilie Abram	4/11/2022	Australian Research Council (ARC)
Integrating Quantum Tech into Space Manufacturing for Defence & Agriculture - Round 12	Ocean & Climate Geoscience	Paul Tregoning	24/03/2022	Commonwealth Department of Industry, Science, Energy and Resources (DISER)
Deciphering strategies polar phytoplankton employ to lessen iron limitation	Ocean & Climate Geoscience - Marine Biogeochemistry	Michael Ellwood	24/01/2022	Australian Research Council (ARC)

Project/Grant Title	Administering Area	Lead CI	Awarded Date	Primary Funds Provider
Integrating Quantum Tech into Space Manufacturing for Defence & Agriculture - Round 12	Ocean & Climate Geoscience	Paul Tregoning	24/03/2022	Commonwealth Department of Industry, Science, Energy and Resources (DISER)
A metal isotope environmental toolkit for tracing emerging heavy-metal pollutants	Ocean & Climate Geoscience	Michael Ellwood	19/01/2022	NZ Ministry of Business, Innovation and Employment
Connecting ocean tides to the large-scale ocean circulation	Ocean & Climate Geoscience	Callum Shakespeare	24/11/2022	Australian Research Council (ARC)
Australian Membership of the International Ocean Discovery Program 2023-24	Ocean & Climate Geoscience	Eelco Rohling	16/11/2022	Australian Research Council (ARC)
GRACE-FO analysis - 2023	Ocean & Climate Geoscience	Rebecca McGirr	20/12/2022	Geoscience Australia
Understanding the nature and drivers of spatial & temporalvariability in the isotopic composition of precipitation across Australia	Ocean & Climate Geoscience	Georgy Falster	21/09/2022	Australian Institute of Nuclear Science and Engineering (AINSE)
How will Pacific climate variability impact Australia in a warming world?	Ocean & Climate Geoscience	Nicola Maher	16/09/2022	Australian Research Council (ARC)
Deciphering strategies polar phytoplankton employ to lessen iron limitation	Ocean & Climate Geoscience - Marine Biogeochemistry	Michael Ellwood	24/01/2022	Australian Research Council (ARC)
Maintaining ANU capabilities in trace element analysis by laser ablation inductively coupled plasmamass spectrometry	RSES - School Administration	Brett Knowles	23/06/2022	Australian National University (ANU)
Queensland Supreme Court Proceeding	RSES - School Administration	William Maher	5/12/2022	Gladstone Ports Corporation
Sedimentary basins: Windows into the dynamics of Australian lithosphere	RSES General (default)	Mark Hoggard	16/08/2022	Australian Research Council (ARC)
MinEx CRC top-up MPhil for Yunqi Wu	RSES General (default)	Yoli Wu	27/09/2022	MinEx CRC Ltd

PEER-REVIEWED PUBLICATIONS

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Arculus, R.* (2022), Arc-Backarc Exchange Along the Tonga-Lau System: Constraints From Volatile Elements. Journal of Petrology (ISSN: 0022-3530), 63(8)

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Burne, R.* (2022), A radical reinterpretation of the growth and form of the stromatolite Conophyton lituus (Maslov) from evidence of syngenetic biofilm mineralisation. Journal of Palaeogeography (ISSN: 2095-3836), 11(1), p.69-84

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Zheng Yong, C., Harima, K., Rubinov, E., McClusky, S.*, Odolinski , R. (2022), Instantaneous Best Integer Equivariant Position Estimation Using Google Pixel 4 Smartphones for Single-and Dual-Frequency, Multi-GNSS Short-Baseline RTK . Sensors (ISSN: 14248220), 22(10)

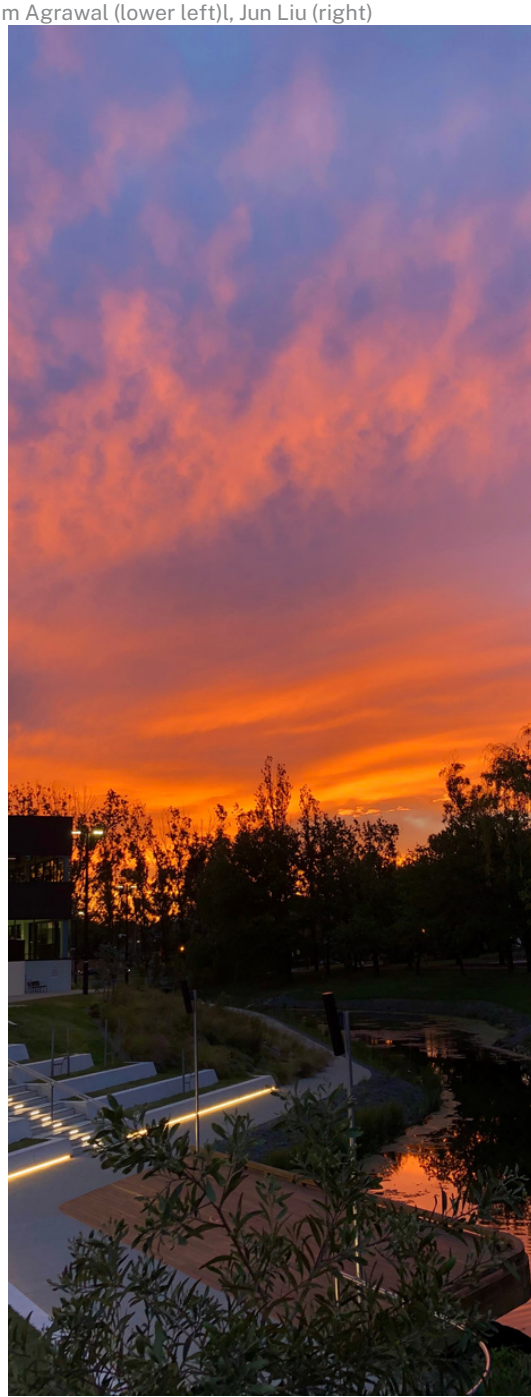
Peer Reviewed Publications

Zhou, L.*, Mernagh, T.* (2022), Combined Focused Ion Beam – Scanning Electron Microscope and Synchrotron X-ray Fluorescence analysis of multi-solid and melt inclusions from the super-giant Grasberg Cu[sbnd]Au deposit, Indonesia. Journal of Geochemical Exploration (ISSN: 0375-6742), 243

Zhou, Z., Breiter, K., Wilde, S., Gao, X., Burnham, A.*, Ma, X., Zhao, J. (2022), Ta-Nb mineralization in the shallow-level highly-evolved P-poor Shihuiyao granite, Northeast China. Lithos (ISSN: 0024-4937), 416-417, p.21

Zhu, Z.*, Campbell, I.*, Allen, C., Brocks, J.*, Chen, B.* (2022), The temporal distribution of Earth's supermountains and their potential link to the rise of atmospheric oxygen and biological evolution. Earth and Planetary Science Letters (ISSN: 0012821X), 580

Credit: Catherine Wilsbacher (top left), Shubham Agrawal (lower left)l, Jun Liu (right)



EVENTS & PUBLIC LECTURES

2022 Chappell Public Lecture

Professor Daniela Rubatto, University of Bern and University of Lausanne, Switzerland.

Daniela Rubatto is a highly awarded Professor of geochemistry at the University of Bern, Switzerland. Her areas of interest and expertise are in isotope geochemistry, metamorphic petrology, mineralogy, tectonics, inorganic geochemistry, and geochronology.

Abstract

Aqueous fluids play a critical role during metamorphic processes in the Earth's crust because they have first-order influence on element transport, reaction kinetics and heat transfer. Understanding their fluxes, sources and interaction with minerals is fundamental for the comprehension of these processes. How, when and where does fluid-mineral interaction take place in metamorphic rocks are basic issues that remain poorly constrained, partly because the fluids eventually escape the rock system leaving a concealed, often invisible path behind.

As fluid interaction can occur during events separated in time and under different physicochemical conditions, micro sampling of distinct minerals and mineral zones is best suited to resolve stages of fluid-rock interaction. I will present an approach that combines in situ oxygen isotope measurements in key minerals, with textural analysis, chemical zoning and modelling to address key questions concerning sources and pathways of fluids in the crust with implications for crustal evolution.

Using case studies, I will show that analyses of distinct mineral zones enable identification of multiple pulses of fluids during the rock evolution and can assist in distinguishing relative timing and sources of fluids. High fluid fluxes are not limited to shear zones and lithological boundaries but can be can be pervasive even at high-pressure conditions. Transient rock volume variations are a likely trigger for extensive fluid influx in rock units at depth. Recycling of weathered lithologies in the deep crust already occurred in the early stages of crustal formation.

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Dr C.M. Eakin	ANU representative Member	ANSIR (Australian National Seismic Imaging Resource) EGU Early Career Award Committee - Seismology Division

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Prof. M.S. Miller	Program Director	AuScope Earth Imaging Program
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Dr M. Norman	Science Editor	GEOLOGY Geological Society of America
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	External Panel Member	Geoscience Australia Science Evaluation
Prof. G.M. Yaxley	Member	Centre for Advanced Microscopy Management Committee

OTHER GRANTS

Professor Brad Pillans recently received an ACT Heritage Grant of $10,552 for “Indigenous welcome signs and online content” at the National Rock Garden. The award was presented by Rebecca Vassarotti MLA, ACT Minister for Heritage, at a ceremony in the historic All Saints Anglican church in Ainslie.

STUDENT NEWS

Fieldtrips

Seventy students & staff from RSES explored the geology of the NSW South Coast for the EMSC1008 1st year fieldtrip. From the rock record they interpreted past climate and sea level change, volcanism, and tectonic deformation from 250+ million years ago

Students walking at the Blue Planet fieldtrip, KNP. Credit: Alysha Jones

ANU and University of Tokyo students prepare to ascend Hōei crater, which was formed by the most recent eruption of Mt Fuji in 1707

20 UG students went to Orpheus Island for the Coral Reefs Field Course

Mt Isa fieldtrip 2022

Stucon

Bake your PhD:
1st: Alysha Jones
2nd: Sarah Jackson
3rd: Madi East

Best talk:
1st: Sarah Jackson
2nd: Jemma Jeffree
3rd: Shubham Agrawal & Matthias Scheiter

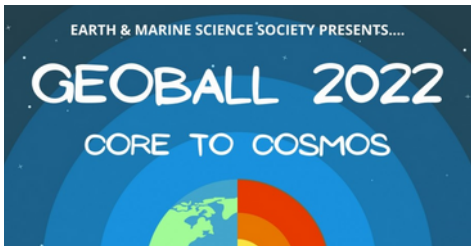
Best Poster:
Oliver Medd

2022 Photo Comp Winners

Most of the beautiful photos illustrating the 2022 annual report are taken from the entries of the 2022 Photo Competition. The winning entries for 2022 were:

RSES on Holidays Joel Tatapudi
RSES in the field: Caleb Bishop
RSES in the lab: Aditya Patkar
RSES samples: Caleb Bishop

GEOBALL! 2022



After a 3 year break the 2022 post covid GeoBall: Core to Cosmos was a great turnout and a big thanks to the organisers the ANU Earth and Marine Science Society. Some of this years award winners were:
Freshest 1st Year: Tom Lindsay
Sickest 2nd Year: Nicko Wyndham
Truest 3rd Year: Jack Dent

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