

# Joshua Shea

Department of Earth Sciences, University of Cambridge  
Postdoctoral Research Associate

📍 Cambridge, United Kingdom  
✉ [joshuajshea@gmail.com](mailto:joshuajshea@gmail.com)

## Research Experience

---

**Postdoctoral Research Associate** with Prof. Olivier Shorttle Nov. 2023 – present  
Department of Earth Sciences, University of Cambridge United Kingdom

- Characterising carbon in Earth's mantle and carbon degassing mechanisms during eruptions using SIMS analysis. Working on mantle melts from high  $^3\text{He}/^4\text{He}$  primordial OIB, and MORB.
- Developed a high-precision SIMS method to concurrently measure carbon and  $\delta^{13}\text{C}$ . Applied the method to basaltic melt inclusions and matrix glasses from Iceland and MORBs.
- Used thermodynamic phase equilibria modelling to explain mantle melting on Mars, meteorite compositions, and to identify primitive melt compositions for sample return campaigns.

**Postdoctoral Research Associate** with Dr. Simon Hunt Sep. 2022 – Nov. 2023  
Department of Materials, University of Manchester United Kingdom

- Conducted high pressure experiments under stress applicable to convection in the transition zone, and machine learning to enhance processing of spectral data on experimental charges.
- Characterised the behaviour of  $\text{Co}_2\text{SiO}_4$  at 4GPa under stress, and developed a machine learning workflow for XRF and EDS spectra mapping data on experimental charges.

**Doctoral Candidate** with Prof. Stephen Foley Sep. 2019 – Sep. 2022  
Department of Earth and Planetary Sciences, Macquarie University Australia

- Thesis title: *'The role of metasomatism in producing mantle sources for continental mafic melts.'* Used eastern Australia as a natural laboratory, combined with experimental petrology.
- Showed metasomatised source assemblages are required to generate intraplate volcanism in eastern Australia. Olivine partitioning differs between alkaline and tholeiitic basalt melts.

## Professional Expertise

---

**Microscopy:** SEM, EPMA, XRF, EBSD, Cathodoluminescence

**Mass spectrometry:** Solution-ICP-MS, LA-ICP-MS, LA-ICP-MS/MS, SIMS, ToF-SIMS.

**Spectroscopy:** Raman Spectroscopy, CHNS analyser.

**Experimental apparatus:** Gas-mixing furnace, Piston-cylinder and Multi-anvil apparatus

**Proficient Programming Languages:** Python, R,  $\text{\LaTeX}$

## Education

---

**Doctor of Philosophy** in Earth and Planetary Sciences 2022  
Macquarie University Australia

**Master of Research** in Earth and Planetary Sciences 2018  
Macquarie University Australia

**Bachelor of Science** major Geology, minor Geography 2016  
Macquarie University Australia

## Teaching Experience

---

**Demonstrator** Earth Sciences, University of Cambridge 2024 – present

- **Part IB: Earth Sciences B**, a second year natural science course; demonstrating classes up to 30 students, covering modules on subsurface processes of the lithosphere and asthenosphere, origin and composition of the rocky planets, differentiation of the Earth, and the dynamic material transport processes of melting, metamorphism and convection.
- **Part II: Earth Sciences**, a third year natural science course; demonstrating classes up to 30 students, teaching an igneous petrology module on global MORB schematics, mantle heterogeneity, magma storage and processing in the crust, and estimating mantle temperature, using data science techniques implemented in python.
- **Part III: Earth Sciences**, a masters level natural science course; demonstrating classes up to 20 students, teaching an igneous petrology module on implementing thermobarometry and diffusion approaches using python.

**Undergraduate Supervisions** King's & Jesus College's, University of Cambridge 2024 – present

- Weekly discussion groups of < 4 students covering material from *Part IB: Earth Sciences B*. I give students questions and essay's, marking these weekly and providing feedback. Covering material on igneous and metamorphic petrology, and phase diagrams used in Earth Sciences.

**Demonstrator** Earth and Planetary Sciences, Macquarie University 2017 – 2022

- **Introduction to Oceanography**, a first year course; and **Geology of Australia**, a second year course; demonstrated practicals, fieldwork, and marked assignments and exams.

## Awards

---

**A. H. Voisey Medal** 2024

New South Wales Division, Geological Society of Australia Australia

- For significant contribution to the Earth Sciences in Australia by an early-career Earth scientist.

## Industry Experience

---

**Engineering Geologist** Mar. 2019 - Sep. 2019 (7 months)

Pells Sullivan Meynink Sydney, Australia

- This role characterised geological materials for mining and infrastructure projects. I primarily worked on the geotechnical site investigation for the Rozelle Interchange, an underground interchange a part of the Westconnex tunnel system. This complex project involved a range of tasks from supervising multiple drill rigs to  $\delta^{14}\text{C}$  dating of sediments.

## Funding and Scholarships

---

**Total funding: approx. £136,000 GBP | \$265,400 AUD**

**Enhancing Research Culture EDI Summer Internship: PI** £3,800 GBP

Wellcome Trust 2023

**Geochronology of the eastern Australian leucitite suite: PI** \$15,000 AUD

National Argon Map, AuScope 2021

**Deciphering the potassic magmas of eastern Australia: PI** \$10,000 AUD

Victorian Division, Geological Society of Australia 2020

<b>Australian Research Council (ARC) Stipend</b>	\$170,000 AUD
Australian Research Council	2019
<b>Research Training Program (Master of Research) Stipend</b>	\$55,000 AUD
Macquarie University	2018
<b>Research Training Pathway Scholarship</b>	\$8,000 AUD
Macquarie University	2017

## Supervisor and Mentoring Experience

---

### Supervisory

I have been primary supervisor for a Wellcome Trust EDI Summer Intern and associate supervisor for a Henry Royce Undergraduate Summer Research Intern.

### Mentoring

I mentor two PhD students at The University of Manchester and The University of Liverpool. I provide advice on executing high-pressure experiments, interpreting data from natural samples and performing micro-analytical geochemical analyses.

## Academic Service

---

<b>Early Career Geoscientist Advisory Panel (ECGAP)</b>	January 2024 - present
National division, Geological Society of Australia	

<b>General Committee Member</b>	October 2023 - present
New South Wales division, Geological Society of Australia	

<b>Reviewer</b>	ongoing
<ul style="list-style-type: none"> <li>- Journal of Petrology, American Mineralogist, Australian Journal of Earth Sciences, Geoscientific Model Development, Open Geoscience.</li> </ul>	

<b>Postdoctoral Research Associate (PDRA) Forum Committee Member</b>	2022 - 2023
Department of Materials, University of Manchester	Manchester, United Kingdom
<ul style="list-style-type: none"> <li>- This committee provided PDRA representation at the Department and Faculty levels and organised social events, such as a fortnightly seminar series.</li> </ul>	

<b>Academic Supervisor, High School Science Extension</b>	2021
Narrabeen High School	Sydney, Australia
<ul style="list-style-type: none"> <li>- Supervised a final-year major project for Science Extension, by providing data and guiding scientific inquisition, at Narrabeen High School, Sydney, Australia.</li> </ul>	

<b>Higher Degree Research Representative</b>	2020 - 2021
School of Natural Sciences, Macquarie University	Sydney, Australia
<ul style="list-style-type: none"> <li>- This role involved representing research students at the department level and guiding peers students towards resources; for example, when student-supervisor relationships decayed.</li> </ul>	

## Equity, Diversity and Inclusion

---

<b>Invisible Disabilities Training</b>	August, 2023
Purple Infusion, through The School of Natural Sciences	The University of Manchester

<b>Wellcome Trust EDI Summer Internship</b>	June-August, 2023
High-Pressure Experimental Materials Lab	The University of Manchester
<ul style="list-style-type: none"> <li>- A funded internship for a penultimate-year undergraduate student who held a scholarship for an under-represented group. It allowed a student who otherwise could not have committed to an unfunded internship experience in a lab and an active research environment.</li> </ul>	

## Professional Affiliations

---

<b>The Geological Society of Australia:</b> General member	2019 – present
<b>The Geochemical Society:</b> General member	2020 – present
<b>European Geosciences Union:</b> General member	2020 – present
<b>The Geological Society of London:</b> Fellow	2023 – present

## Fieldwork

---

**Total: 30.5 weeks, approx. 7.5 months** | \* indicates fieldwork I helped organised

<b>Cornish Granites, United Kingdom</b> (1 week)	2023
<b>Eastern Australian Potassic Volcanism II, NSW, Australia*</b> (2 weeks)	2020
<b>Eastern Australian Potassic Volcanism I, NSW, Australia*</b> (2 weeks)	2019
<b>Rozelle Interchange Site Investigate, Rozelle, NSW, Australia*</b> (3 months)	2019
<b>Eastern Australian Volcanic Province, NSW, Australia*</b> (1.5 weeks)	2018
<b>Final-year undergrad. mapping, Olary, SA, Australia</b> (2 weeks)	2017
<b>Undergrad. volcanology, New Zealand</b> (2 weeks)	2016
<b>Undergrad. mapping, Goulburn, NSW, Australia</b> (1 week)	2016
<b>Undergrad. geomorphology, Gloucester, NSW, Australia</b> (1 week)	2016
<b>Undergrad. geomorphology, Lake Macquarie, NSW, Australia</b> (1 week)	2016
<b>Volcanology field course, Hawai'i, Hawai'ian Islands, USA</b> (3 weeks)	2015
<b>Undergrad. sedimentary, South Coast, NSW, Australia</b> (1 week)	2015
<b>Undergrad. mapping, Lake Keepit, NSW, Australia</b> (1 week)	2014

## Selected Talks and Conference Presentations

---

### Invited Talks (2/4)

**Invited Seminar** (March 2025): **Shea JJ**, Soderman CR. Mantle melting on Mars with applications for sample return. *Mars Forum, NASA Jet Propulsion Laboratory, California Institute of Technology*, online

**Department Seminar** (December 2022): **Shea JJ**, Ezad IS, Foley SF. A lattice strain approach to partitioning between olivine and alkaline melts. *Institut für Mineralogie, Universität Münster*, Münster, Germany

### Presenting Author Conference Presentations (2/5)

**Poster** (December 2024): **Shea JJ**, Hughes CE, Bindemann I, Blundy J, Brooker R, Botcharnikov R, Cartigny P, EIMF, Gaetani G, Kilgour G, MacLennan J, Monteleone B, Neave DA, Shorttle O. Enhanced precision on *in situ* measurements of stable carbon isotope ratios in basaltic glasses *American Geophysical Union meeting (AGU)*, Washington, D.C., United States of America.

**Talk** (June 2022): **Shea JJ**, Ezad IS, Foley SF, Lanati AW. The Eastern Australian Volcanic Province, its primitive melts, constraints on melt sources and the influence of mantle metasomatism. *Goldschmidt*, Hawaii, United States of America.

## Co-author Conference Presentations (2/5)

**Talk** (August 2024): Monteleone B, Gaetani G, Marshall H, **Shea JJ**, Urann BM, Taracsák Z, Shorttle O. Recent advances in the measurement of volatile stable isotopes (C, B and S) by secondary ion mass spectrometry. *Goldschmidt*, Chicago, United States of America.

**Talk** (September 2022): Manassero MC, Özaydin S, Afonso JC, **Shea JJ**, Kirkby A, Czarnota K., Jones A. Joint probabilistic Inversion of 3D Magnetotelluric and Seismic Data in Southeast Australia *The international Electromagnetic Induction Workshop*, Çeşme, Turkey.

## Publication List

**Summary:** My work has accrued 69 citations since 2019 and a h-index of 5. | *In preparation articles listed are >80% complete.*

**Shea JJ**, Lanati, AW, Ezad IS, Foley SF. *in preparation*. Intraplate lamproites derived from hydrous pyroxenites throughout eastern Australia. *In preparation for submission to Contributions to Mineralogy and Petrology*.

Lanati, AW, **Shea JJ**, Foley SF, Klöcking M, Gerdes-Berndt J, Rohrbach A, Klemme S. *under review*. The Petrology, Geochemistry, & Origin of the East Australian Potassic Suite: Bulk Chemistry & Genesis. *Under review at Journal of Petrology*.

**Shea JJ**, Soderman CR, Teece BL, Weller OM, Barge LM, Shorttle O. *under review*. Mantle melting on Mars with applications for sample return. *Under review at Earth and Planetary Science Letters*.

Evans AJM, Farrel NJC, Neave DA, Heartley ME, Healy D, Waters JP, McElhinney, **Shea JJ**, Bigaroni N, Hunt SA. *under review*. Field fracture analysis on lithium bearing Cligga Head granite: understanding critical mineral mobilisation from fluid flow. *Journal of Structural Geology*.

Ezad IS. **Shea JJ**, Foley SF. *minor revisions*. Hydrous minerals are sinks for first row transition elements in the mantle: an experimental partitioning study. *minor revisions at Chemical Geology*.

Davies JH, Panton J, Altoe I, Andersen M, Béguelin P, Biggin A, Davies C, Elliott T, Engbers YA, Fernandes VM, Ferreira AMG, Fowler S, Ghelichkhan S, Koelemeijer P, Latallier F, Li W, Morgan G, Mason SJ, Myhill R, Nowacki A, Récalde N, O'Malley C, Plimmer A, Porcelli D, Roberts GG, Rodney JB, **Shea JJ**, Shorttle O, Sturgeon W, Walker AM, Ward J, Wookey J. *accepted, in press*. How to assess similarities and differences between mantle circulation models and Earth using disparate independent observations. *Accepted at The Proceedings of the Royal Society A*.

**Shea JJ**, Hughes CE, Bindemann I, Blundy J, Brooker R, Botcharnikov R, Cartigny P, EIMF, Gaetani G, Kilgour G, MacLennan J, Monteleone B, Neave DA, Shorttle O. *accepted, in press*. **Improving Precision and Reference Materials for Stable Carbon Isotope Analysis in Basaltic Glasses using Secondary Ion Mass Spectrometry**. *Accepted at Geostandards and Geoanalytical Research*.

Buckingham M, **Shea JJ**, Quan KZ, Lo PME, Swindell J, Xiao W, Lewis D, Eggerman A, Hunt SA. 2025. **Using high pressure to investigate the stability of high entropy wurtzite structured (MnFeCuAgZnCd)S**. *Communications Chemistry*, 8, 65.

Chen C, Förster MW, Ezad IS, **Shea JJ**, Shcheka SS, Jacob DE, Foley SF. 2025. **Sulfide-rich continental roots at cratonic margins formed by carbonated melts**. *Nature*, 637, 615–621.

Manassero MC, Özaydin S, Afonso JC, **Shea JJ**, Kirkby A, Ezad IS, Fomin I, Czarnota K. 2024.

Lithospheric structure and melting processes in southeast Australia: new constraints from joint probabilistic inversions of 3D magnetotelluric and seismic data. *Journal of Geophysical Research: Solid Earth*, 129, e2023JB028257.

**Shea JJ**, Foley SF, Dalton H, Lanati, AW, Phillips D. 2024. Mid-Jurassic intraplate volcanism at Bokhara River, and insight into metasomatism in the lithospheric mantle of the Thompson Oregon, eastern Australia. *Australian Journal of Earth Sciences*; 71.

Ezad IS, Shcheka SS, Buhre S, Gorjovsky LR, **Shea JJ**, Förster MW, Foley SF. 2023. Rapid quench piston-cylinder apparatus: an improved design for the recovery of volatile-rich geological glasses from experiments at 0.5 – 2.5 GPa. *Review of Scientific Instruments*; 94, 055107.

**Shea JJ**, Ezad IS, Lanati, AW, Foley SF. 2022. The Eastern Australian Volcanic Province, its primitive melts, constraints on melt sources and the influence of mantle metasomatism. *Earth-Science Reviews*; 233, 104168

Liu Z, **Shea JJ**, Foley SF, Bussweiler Y, Rohrbach A, Klemme S, Berndt J. 2020. Clarifying source assemblages and metasomatic agents for basaltic rocks in eastern Australia using olivine phenocryst compositions. *Lithos*; 390–391

**Shea JJ**, Foley SF. 2019. Evidence for a Carbonatite-Influenced Source Assemblage for Intraplate Basalts from the Buckland Volcanic Province, Queensland, Australia. *Minerals*; 9(9):546