

DR FRED RICHARDS

Lecturer, Imperial College London

Geophysicist and geologist with expertise in geodynamics, palaeoclimate, petrology and surface processes.

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EMPLOYMENT

Jan 2023 – Present: Assistant Professor in Earth Sciences

Department of Earth Science and Engineering, **Imperial College London**.

- By correcting ancient shorelines for mantle-flow-induced vertical deflections, I have produced revised sea-level estimates for past warm periods that reduce recent projections of end-of-century sea-level rise by ~70%.
- Forged new collaborations with Brown, UNH and Tokyo working on solid Earth-cryosphere interactions.

Oct 2019 – Jan 2023: Imperial College Research Fellow

Department of Earth Science and Engineering, **Imperial College London**.

- Generated unified models of Earth's structure and dynamics that reconcile full range of geophysical and geochemical observations for the first time.
- Expanded my collaborative network (Oxford, Cambridge, Imperial, UCSC, Berkeley, UVic, Los Alamos, New Mexico Tech, GFZ Potsdam and Ca' Foscari) to assemble toolkit for quantifying impact of revised Earth models on ice-sheet stability, volcanism, and landscape evolution.

Sep 2018 – Sep 2019: Schmidt Science Fellow

Department of Earth and Planetary Sciences, **Harvard University**.

- Built collaborations at Harvard, Columbia, and ANU to develop new methodologies for mapping the physical state of Earth's interior and its control on mineral deposit formation, sea level, and orbital cycles.
- Mineral deposit research estimated to be worth [A\\$147-752 million](#) to the Australian economy by independent consultancy, ACIL Allen; covered in [The Economist](#) and [Scientific American](#).

QUALIFICATIONS

Oct 2014 – Aug 2018: PhD Earth Sciences – passed with no corrections.

Bullard Laboratories, Department of Earth Sciences & Jesus College, **University of Cambridge**.

Oct 2010 – Jun 2014: MSci Earth Sciences: 1st Class Honours – graduated top of the class.

Department of Earth Sciences & St. Anne's College, **University of Oxford**.

FUNDING (TOTAL: ~£420,000)

2023–2024 Geoscience Australia Exploring for the Future Program (£95,000; PI)

"Dynamics of Australian Upper Mantle: Impacts on Sea Level and Mineral Deposit Formation"

Schmidt Science Fellows Catalyst Grant (£8,000; Co-PI)

"Ice and Fire: Quantifying the Impact of Mantle Heat on Future Antarctic Ice Sheet Stability"

2022–2023 Imperial College Wings for Ideas Fund (£2,500; PI)

"Making Machine Learning-Based Treasure Maps for Critical Metal Resources", 1 of 5 selected.

2020–2023 SSCP DTP Fieldwork Fund (£10,000; PI) for Greenland fieldwork and sample analysis.

2019–2023 Imperial College Research Fellowship (~£224,000; PI)

"Quantifying the Impact of Earth's Internal Dynamics on the Cryosphere", 1 of 20 selected.

2018–2019 Schmidt Science Fellows in partnership with the Rhodes Trust (\$100,000; ~£80,500; PI)

"Contribution of Solid Earth Dynamics to Late Cenozoic Relative Sea-Level Change", 1 of 14 selected in inaugural class, only successful UK applicant and only Earth scientist.

SELECTED AWARDS

2022 Geological Society of London William Smith Fund for "excellence in contributions to applied and economic aspects of geoscience" (1 award per year; £500 prize).

2018 **Royal Astronomical Society Keith Runcorn Prize** for best thesis in geophysics and planetary science – runner-up (**1 award per year**).

DEVELOPING OTHERS

Research Supervision	<ul style="list-style-type: none"> • 2020–: Lead supervisor of 2 PhDs with 3 published papers and 2 drafted. With my support, they secured one Outstanding Student Presentation Award at AGU 2021, one 3-month research visit (Tokyo), and fully-funded places at 3 highly selective workshops. • 2022–: Co-supervisor of 1 PhD with 1 manuscript published and 1 in rev. • 2022–: Lead supervisor of 3 MScs with final marks of (77%, 85%, and 84%).
Supporting ECRs	<ul style="list-style-type: none"> • 2020–2023: Events Team Lead, RAS Early Career Network. Organised and chaired 6 personal development events, published 4 articles in <i>A&G</i> to highlight learning outcomes.
Personal Tutoring	<ul style="list-style-type: none"> • 2022–: Personal tutor (9 UGs). Developed scientific communication, CVs, and problem solving. Mentoring and references helped first-generation student secure PhD at Stanford. • 2022–: Course tutor (21 MScs), giving career guidance and writing references. • 2022–: Mapping advisor (21 UGs), helping with logistics and defining research question.
Student Outreach	<ul style="list-style-type: none"> • 2021–: Speaker for Sutton Trust Summer School, ESE Taster and Admissions Days, Imperial Taster Lectures, and School21 to encourage students from underrepresented backgrounds to study geology.

INDICATORS OF ESTEEM

Invited Talks	<ul style="list-style-type: none"> • 20 invited conference talks and departmental seminars, including: SEG (keynote), SEDI AGU, EGU, IUGG, Harvard, Columbia, Cambridge, Leeds, ETH Zurich, and ANU.
Invited Pubs.	<ul style="list-style-type: none"> • 2 chapters (<i>Encyclopædia of Quaternary Science & Elsevier Science</i>); 1 paper (<i>PEPI</i>).
News Coverage	<ul style="list-style-type: none"> • Research covered in The Economist, Scientific American, Mining Journal, and Eos.
Invited Roles	<ul style="list-style-type: none"> • Leadership team of SCAR INSTANT and Mineralogical Society MPG working groups. • Developer of NSF-supported convection code ASPECT (aspect.geodynamics.org).
Peer Review	<ul style="list-style-type: none"> • Publications: <i>AGU Advances</i>; <i>AGU Books</i>; <i>Comms. Earth Env.</i>; <i>Earth-Sci. Reviews</i>; <i>G³</i>; <i>Geology</i> (3); <i>GJI</i>; <i>GRL</i>; <i>JGR</i> (2); <i>Mar. Geophys. Res.</i>; <i>Nature Sci. Rep.</i>; <i>Nature Comms.</i>; <i>PEPI</i>; <i>Proc. R. Soc. Lond.</i>; <i>Science Advances</i> (2); <i>Tectonophysics</i>. • Grants: <i>NASA (US)</i>; <i>SNSF (CH)</i>; <i>ANR & IPEV (FR)</i>; <i>Schmidt Science Fellows (US/UK)</i>.

KEY PUBLICATIONS (full list: tinyurl.com/4zw5vfa9; 31 published, 3 in rev.; † = equal input; * = PhD student)

*Hazzard, J. A. N. & Richards, F. D. (2024). Antarctic geothermal heat flow, crustal conductivity and heat production inferred from seismological data, *GRL*, **51**, e2023GL106274. [\[PDF\]](#) – *Novel probabilistic inverse framework for inferring subglacial heat flow that significantly improves fit to available Antarctic measurements.*

Richards, F. D., Coulson, S. C., Hoggard, M. J., Austermann, J., Dyer, B. & Mitrovica, J. X. (2023). Geodynamically corrected Pliocene shoreline elevations in Australia consistent with midrange projections of Antarctic ice loss, *Sci. Adv.*, **9**, eadg3035. [\[PDF\]](#) – *New ice volume estimate from ML-based probabilistic inversion of geodynamic models and geomorphic data implies Antarctic Ice Sheet less vulnerable than previously predicted.*

Richards, F. D., Hoggard, M. J., Ghelichkhan, S., Koelemeijer, P. & Lau, H. C. P. (2023). Geodynamic, Geodetic and Seismic Constraints Favour Deflated and Dense-Cored LLVPs, *EPSL*, **602**, 117964. [\[PDF\]](#) – *New Earth model that reconciles previously discrepant geophysical and geochemical data.*

*Hazzard, J. A. N., Richards, F. D., Roberts, G. G. & Goes, S. D. B. (2023). Probabilistic Assessment of Antarctic Thermomechanical Structure: Impacts on Ice Sheet Stability, *JGR*, **128**, e2023JB026653. [\[PDF\]](#) – *Innovative method for estimating mantle viscosity, its timescale-dependence, and its control on future sea-level change.*

Hoggard, M. J.[†], Czarnota, K.[†], Richards, F. D.[†], Huston, D. L., Jaques, A. L. & Ghelichkhan, S. (2020). Global distribution of sediment-hosted metals controlled by craton edge stability, *Nat. Geosci.*, **13**, pp. 504-510. [\[PDF\]](#) – *Discovery reduces search space for new critical metal resources by two thirds.*