



# FREYA R. GEORGE

She/her/hers  
fgeorge7@jhu.edu  
+1(443)682-5458  
 @freyargeorge

 freyageorge-geology.com

Morton K. Blaustein Department of Earth & Planetary Sciences  
The Johns Hopkins University  
221 Olin Hall, 3300 San Martin Drive  
Baltimore, MD, 21218

## PRIMARY RESEARCH INTERESTS

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I am a petrologist with particular interest in the pressure–temperature conditions of crustal metamorphism linked to the kinetics of mineral nucleation and growth, the formation and evolution of metamorphic microstructures, and fluid–rock interaction during reaction. My approach to date has interrogated the spatiotemporally resolved chemical and microstructural records contained within metamorphic rocks and minerals by applying a multi-disciplinary toolkit of novel analytical, petrographic, and modelling approaches.

## EDUCATION

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- 2014–2019 **Ph.D. in Earth Sciences** (University Senate Medal Recipient), Carleton University, Canada  
Thesis: “Rates and mechanisms of metamorphic processes associated with the India–Asia collision in the Sikkim Himalaya.”  
Supervisor: Fred Gaidies
- 2010–2014 **B.A. and M.Earth Sci. in Earth Sciences** (1<sup>st</sup> Class Honors), University of Oxford, UK  
Dissertation title: “Petrology and petrogenesis of garnet-bearing rocks from the Jijal Complex, Pakistan Himalaya.”  
Supervisor: Dave Waters

## RELEVANT EMPLOYMENT HISTORY

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- Oct. 2020– **Blaustein Postdoctoral Fellow**, The Johns Hopkins University, Baltimore, MD, USA
- 2019–2020 **UK–US Fulbright Postdoctoral Scholar**, The Johns Hopkins University, Baltimore, MD, USA
- 2014–2019 **Research Assistant**, Carleton University, Ottawa, Canada
- 2014–2019 **Teaching Assistant**, Carleton University, Ottawa, Canada
- 2018–2020 **Freelance Scientific Editor, Stallard Scientific Editing**
- 2013 **Geoscience Intern, BP, Aberdeen, Scotland**

## PROFESSIONAL RECOGNITION

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### Awards, Honors, Fellowships

- 2021 Journal of Metamorphic Geology’s Mike Brown Early Career Scientist Best 2020 Publication for “scientific originality, rigour in research methodology, relevance and significance to understanding metamorphic processes” to George *et al.*, 2020
- 2020 McGill University 2020–2022 Wares Postdoctoral Fellowship (declined)
- 2020 Johns Hopkins University 2020–2022 Blaustein Postdoctoral Fellowship
- 2019 US–UK Fulbright Commission–Lloyd’s of London Scholar Award
- 2019 Carleton University Senate Medal for Outstanding Academic Achievement

- 2018 Best Student Presentation, UK Metamorphic Studies Group Annual Research-in-Progress Meeting
- 2016 Outstanding Student Poster and PICO (OSPP) Award, EGU General Assembly
- 2014 Achievement Award for academic standing, St Anne's College, University of Oxford
- 2013 University of Oxford Student Award from Mineralogical Society of Great Britain and Ireland for best undergraduate performance in mineralogy

### Bursaries and Funding

- 2018–2019 Ontario Graduate Scholarship (CAD 15,000 over three academic terms)
- 2017 Walker Mineralogical Society Peacock Prize (CAD 1,700)
- 2017 AGU Postgraduate Travel Grant (USD 500), for travel to attend AGU conference
- 2016 David and Rachel Epstein Foundation Grant (CAD 1,000)
- 2016 Carleton University Academic Staff Association Grant (CAD 2,000)
- 2015 Mineralogical Association of Canada Student Research Grant (CAD 1,200) for “Rates of metamorphic processes in the inverted metamorphic sequence in Sikkim Himalaya, NE India: Using selective fragmentation to access garnet cores”
- 2014–2018 Ontario Trillium Scholarship (CAD 60,000/year over four years)

## RESEARCH OUTPUT AND DISSEMINATION

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### Visiting lectures and seminars

- April 2021 “From microscale observations to plate tectonics: using the chemistry and microstructure of minerals as time capsules of metamorphic processes.” Humboldt State University Department of Geology, virtual seminar.
- May 2020 “Oscillatory major element and isotopic zoning in high-pressure garnet a record of non-uniform transfer processes?” Canada–UK Metamorphic Virtual Seminar Series.
- July 2019 “Crystallization of metamorphic garnet in the Sikkim Himalaya: insights into element equilibration, rock-wide deformation and rates of Barrovian heating”. Jackson School of Geosciences DeBuhr Lecture Series, Austin, Texas, USA.
- Oct. 2017 “Anatomy of a Mountain Belt: understanding orogenesis in the Sikkim Himalaya”. Walker Mineralogical Society, Toronto, Ontario, Canada.
- May 2016 “Rates and mechanisms of porphyroblast crystallisation: insights from a garnet-grade schist of the Lesser Himalaya.” ETH Zurich Department of Earth Sciences, Switzerland.

### Published or accepted peer-reviewed publications

6. **George, F.R.**, Waters, D.J., Gough, S., Searle, M.J., Forshaw, J. (in press). Metamorphic constraints on the high temperature building of an arc: the Jijal garnet granulites, northern Pakistan. *Journal of Metamorphic Geology*. (Manuscript available on request)
5. Gaidies, F., **George, F.R.**, (2021). The interfacial energy penalty to the growth of porphyroblasts. *Geology*, doi:10.1130/G48715.1.
4. Guice, G. L., Ackerson, M. R., Holder, R. M., **George, F. R.**, Browning-Hanson, J., Burgess, J. L., Foustoukos, D. I., Becker, N. A., Nelson, W., Viète, D. R. (2021) Suprasubduction (SSZ) ophiolite fragments in the central Appalachian Orogen, USA: evidence for the mantle and Moho in the Baltimore Mafic Complex (Maryland). *Geosphere*, doi: 10.1130/GES02289/1.
3. **George, F.R.**, Gaidies, F. (2020). Simultaneous operation of opposing reaction mechanisms: the influence of matrix heterogeneity on post-kinematic garnet crystallisation in an inverted metamorphic sequence. *Journal of Metamorphic Geology*, 38, 743–769, doi: 10.1111/jmh.12539.

2. **George, F.R.**, Gaidies, F., Boucher, B. (2018). Population-wide garnet growth zoning revealed by LA-ICP-MS mapping: implications for trace element equilibration and syn-kinematic deformation during crystallisation. *Contributions to Mineralogy and Petrology*, 173(9), p.74, doi: 10.1007/s00410-018-1503-0.
1. **George, F.R.**, Gaidies, F. (2017). Characterisation of a garnet population from the Sikkim Himalaya: insights into the rates and mechanisms of porphyroblast crystallisation. *Contributions to Mineralogy and Petrology*, 172(7), p.57, doi: 10.1007/s00410-017-1372-y.

### Conference proceedings and invited talks

- **George, F.R.**, 2021. Decoupled oscillatory and O-isotope zonation: records of heterogeneous fluid transfer processes. EGU General Assembly Conference Abstracts. **(Invited virtual talk)**
- **George, F.R.**, 2021. There's no accounting for oscillations: rhythmic garnet zoning unrelated to heterogeneous high pressure low temperature fluid transfer? Metamorphic Studies Group Research in Progress Annual Meeting, UK. **(Keynote speaker)**
- Burgess, J.L., **George, F.R.**, Piccoli, P., Viete, D.R., 2021. New approaches to discern the potentially polymetamorphic history of the Gassetts Schist, Vermont. Geological Association of Canada–Mineralogical Association of Canada Joint Annual Meeting.
- **George, F.R.**, Viete, D.R., Ávila, J., Seward, G.E., Poirer, G., Dierkrup, D., 2020. Oscillatory major element and isotopic zoning in high-pressure low-temperature garnets: records of non-uniform fluid transfer processes? Geological Society of America Connects Online. **(Invited virtual talk)**
- Guice, G. L., Ackerson, M. R., Holder, R. M., **George, F. R.**, Browning-Hanson, J., Burgess, J. L., Foustoukos, D. I., Becker, N. A., Nelson, W., Viete, D. R., October 2020. The Baltimore Mafic Complex, Maryland: ophiolite fragments in the southern Appalachian Orogen, *GSA Connects Online*.
- **George, F.R.**, Gaidies, F., 2020, Post-kinematic and matrix-dependent garnet nucleation and growth in the inverted Barrovian metamorphic sequence of the Sikkim Himalaya. Metamorphic Studies Group Research in Progress Annual Meeting, UK. (Virtual poster)
- **George, F.R.**, Viete, D.R., Ávila, J., Seward, G.E., 2020. Oscillatory and stepwise compositional zoning in high pressure–low temperature garnets: records of transient and spatially-variable fluid-fluxing during subduction? EGU General Assembly Conference Abstracts, p. 9077. (Virtual talk)
- **George, F.R.**, Gaidies, F., 2019. Porphyroblastic microstructures and metamorphic grade: controls on systematic trends from a Himalayan inverted Barrovian sequence, Geological Society of America Annual Meeting, Phoenix, Arizona. **(Invited talk)**
- **George, F.R.** Gaidies, F., 2018. 3D textural and geochemical porphyroblast analysis: unraveling the integrated history of nucleation, growth, and deformation. European Geosciences Union General Assembly Abstracts, Vol. 20, p. 10102. **(Invited talk)**
- **George, F.R.**, Gaidies, F., 2018. Chromium spirals in garnet: a record of deformation during crystallisation? Metamorphic and Tectonic Studies Group Research in Progress Annual Meeting, UK. (Talk)
- **George, F.R.**, Gaidies, F., 2017. Differential equilibration and intergranular diffusion of trace elements during rapid regional metamorphism: constraints from LA-ICP-MS mapping of a garnet population. AGU Fall Meeting Abstracts, p. V31D-06. (Talk)
- **George, F.R.**, Gaidies, F., 2017. LA-ICP-MS trace element maps of a garnet population: insights into the crystallisation of a metamorphic garnet population. EGU General Assembly Abstracts, Vol. 19, p. 9661. (Talk)

- **George, F.R.**, Gaidies, F., 2016. Rates and mechanisms of porphyroblast crystallisation: Insights from a garnet-grade schist of the Lesser Himalaya. European Mineralogical Conference Abstracts. (Talk)
- **George, F.R.**, Gaidies, F., 2016. Characterisation of a garnet population from the Sikkim Himalaya: implications for the state of equilibrium during prograde metamorphic crystallisation. Advances in Earth Sciences Research Conference annual meeting, Ottawa, Canada. (Talk)
- **George, F.R.**, Gaidies, F., 2016. Characterisation of a garnet population from the Sikkim Himalaya: implications for the rates and mechanisms of porphyroblast crystallisation. EGU General Assembly Conference Abstracts. Vol. 18, pp. 5040. (Poster)
- Waters, D.J., **George, F.**, Searle, M., Gough, S., 2015. Metamorphic constraints on the building of an arc: the Jijal garnet granulites, Northern Pakistan. Geological Society of Great Britain and Ireland's Metamorphic Studies Group annual meeting, Keyworth Nottingham, UK. (Poster)
- **George, F.**, Waters, D.J., Searle, M., 2014. Petrology and petrogenesis of garnet-bearing rocks of the Jijal Complex, Pakistan Himalaya. Geological Society of Great Britain and Ireland's Metamorphic Studies Group annual meeting, Milton Keynes, UK. (Poster)

## TEACHING AND ADVISING

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### Teaching Roles:

Lecture and Laboratory courses (as a teaching assistant/demonstrator, Carleton University):

- Metamorphic Petrology (3<sup>rd</sup> year undergraduates, 5 times, 2015–2019)
- Thermodynamics, Kinetics and Advanced Metamorphic Petrology (graduates, 2 times)
- Structural Geology (3<sup>rd</sup> year undergraduates, 1 times)
- Geological Map Interpretation (2<sup>nd</sup> year undergraduates, 3 times)
- Earth Systems Through Time (1<sup>st</sup> year undergraduates, 1 time)
- Natural Disasters (2<sup>nd</sup> year undergraduates, 1 time, online virtual learning course)

Guest Lectures:

- Stable isotopes in high-temperature igneous and metamorphic systems (Feb. 2021, Johns Hopkins)
- Ophiolites as a lithospheric framework, using examples from the Baltimore Mafic Complex (April 2021, Humboldt State University)

Field courses (Carleton University)

- Introductory Field Geology and Mapping (Grenville Province, 2<sup>nd</sup> year UG, 4 times, 2015–2019)
- Advanced Field Geology (Swiss–Italian Alps, 4<sup>th</sup> year UG and G, 2018)
- Numerous weekend trips in the Ottawa Ordovician cover and Grenvillian Basement (2015–2019)

## COMMUNITY ENGAGEMENT

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### Institutional responsibilities

2021–	Postdoctoral representative for Krieger School of Arts and Sciences, Johns Hopkins University
2020–	Laboratory manager of the Tectonics, Metamorphism, Petrology and Orogeny group's laser ablation-ICP-MS lab, Johns Hopkins University
2015+2016	Graduate student representative, Carleton Earth Sciences Hiring Committee
2015–2018	President, Graduate Students in Earth Sciences Society, Carleton University
2011–2012	President, Oxford University Geological Society, University of Oxford

## Memberships and societal activities

- Oct. 2020 Session chair, GSA Connects Online 2020 Session T38  
July 2020 Co-chair, Goldschmidt 2020 Session 04h  
2020– NSF postdoctoral fellowship application reviewer  
2018– Manuscript reviewer for: *Contributions to Mineralogy & Petrology*, *Journal of Metamorphic Geology*, *Geoscience Frontiers*, *EGU Solid Earth*, *Journal of Petrology*  
2017– Member, American Geophysical Union  
2016– Member, European Geosciences Union  
2014– Member, Geological Society of America

## Communication & outreach:

- Jan. 2021– **Unlearning Racism in Geosciences (URGE) POD Member**  
Participating member of the Johns Hopkins Earth and Planetary Sciences Pod.
- June 2020 **EDI discussion in Canada–UK Metamorphic Virtual Seminar Series**  
Led discussion and circulated resources pertaining to the improvement of EDI practices in the metamorphic geology community.
- 2019– **Request a Woman in STEM, Member**  
Part of a network of women scientists with a commitment to speaking up for science and for marginalized communities in science at the community level. Member of both Ottawa and Baltimore pods.
- 2019– **'Skype a Scientist'**  
Video sessions with schoolchildren to discuss what work as a geologist entails, explain how we look at rocks in the field and answer general questions posed by students. Six sessions conducted since September 2019 with first and third grade cohorts.
- 2017/18 **Geoheritage Days**, Carleton University  
Annual public outreach with an aim of engaging the Ottawa public in specific and significant geological sites in the vicinity of their homes.
- 2012–14 **Stargazing Live volunteer**, University of Oxford Physics Department
- 2011–2014 **Department of Earth Sciences Open Days**, University of Oxford

## RESEARCH EXPERIENCE

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### Analytical and laboratory experience

**High-resolution X-ray  $\mu$ -computed tomography (XR-CT):** Scanning and imaging of geological and non-geological materials, paleontological scans; data processing; training new users and external clients.

**Electron probe microanalysis (EPMA):** major- and trace-element WDS spot analyses and mapping.

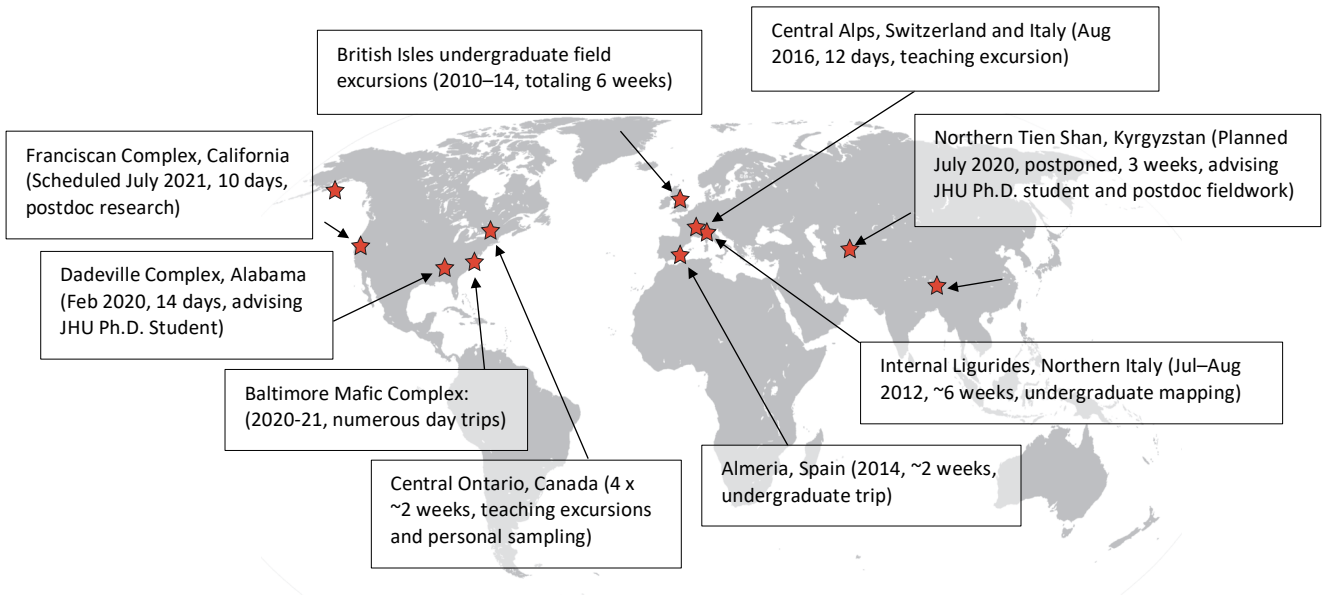
**Scanning electron microscopy (SEM):** BSE, SE, and cathodoluminescence imaging; energy-dispersive spectrometry mineral chemistry and standardisation; high-angular-resolution electron backscatter diffraction (EBSD).

**Laser ablation–inductively coupled plasma–mass spectrometry (LA-ICP-MS):** U–Pb dating of zircon and monazite, and multi-material trace element analyses via mapping and spot analyses on a triple-quadrupole single-collector; instrument maintenance and servicing; training new users and students.

**Secondary ionized mass spectrometry (SIMS):** O-isotopes in garnet, sample preparation and standardisation, data reduction.

## Rock preparation, mineral separation, polishing, optical microscopy

### Extended fieldwork



### Specialist training and other qualifications

2017	RIMG European Geosciences Union short course, 'Petrochronology: Methods and Applications'
2016	European Mineralogical Union School on Mineral Reaction Kinetics
2014	Geological Society of America Geochronology Short Course
2017-	Illustrator, Matlab, AvisoFire, ProbeSoftware
Valid	British and Canadian driving licenses