NICHOLAS ASHMORE

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Civil engineer and hydrogeologist with expertise in numerical modeling, programming, field and lab techniques, and research interests in geoenergy topics such as CO_2 storage and hydrogen. Passionate about the responsible application of geoenergy to achieve climate goals.

Research Experience

Doctor of Philosophy, Geology and Geophysics, University of Edinburgh *2021 – 2025*

Thesis: *Predicting the fate and migration of CO2 in carbon storage reservoir overburden (Supervisor: Dr. Ian Molnar)*

Funding Institution: UK Natural Environment Research Council, E4 Doctoral Training Program

- Simulating the fate of carbon dioxide in the overburden by developing numerical models in both MATLAB and C++
- Investigating the impacts of geoenergy applications such as CO_2 storage on aquifers
- Analyzing the effect of subsurface properties on the migration of gaseous CO_2 in the shallow subsurface

Master of Applied Science, Civil Engineering, Queen's University, Kingston, Canada *2018 - 2020*

Thesis: *Stray Gas Migration: Multicomponent Mass Transfer Effects on Dissolution and Persistence of Gas in the Subsurface (Supervisor: Dr. Kevin Mumford)*

Funding Institution: Natural Science and Engineering Research Council of Canada

- Conducted lab scale experiments to understand the dissolution of trapped methane and natural gas in aquifers
- Simulated laboratory results using the reactive transport model MIN3P
- Developed skills in laboratory experimental design, and analytical methods such as gas and ion chromatography

Undergraduate Research Assistant, Western University, London, Canada *2016, 2017*

Supervisor: Dr. Clare Robinson

- Conducted long-term field monitoring of contaminant transport at groundwater – surface water interfaces on Great Lake beaches
- Assisted with regional field survey of Radon-222 to quantify lacustrine groundwater discharge, gaining experience in large scale field studies
- Built and installed equipment (e.g. nested piezometers, multilevel pore-water samplers) for field studies

Publications

Ashmore, N.A., Krol, M. M., Gilfillan, S. M. V., Van De Ven, C.J.C, Mumford, K. G., Molnar, I. L. (2024). Simulation of bench-scale CO_2 injection using a coupled continuum-discrete approach. *Science of the Total Environment, 176639.* https://doi.org/10.1016/j.scitotenv.2024.176639.

Ashmore, N. A., Van De Ven, C. J. C, Mumford, K. G. (2024). Importance of Multicomponent Mass Transfer on the Dissolution of Trapped Gas: A Focus on Geo-Energy Applications in the Shallow Subsurface. *ACS ES&T Engineering*, *4(2)*, 290-299 https://doi.org/10.1021/acsestengg.3c00150.

Ashmore, N. A., Van De Ven, C. J. C, Molofsky, L. J., & Mumford, K. G. (2022). Calculation of gas ratios for use in stray gas migration investigation and characterization. *Groundwater*, *60*(3), 312-317, https://doi.org/10.1111/gwat.13183.

Teaching Experience

Tutor, University of Edinburgh, School of GeoSciences *2021 - Present*

Hydrogeology 1: Applied Hydrogeology: Dr. Chris McDermott

- Planned and delivered multiple problem-based tutorials each week, including solved problems on the board

Hydrogeology 2: Simulation of Groundwater Flow and Transport: Dr Chris McDermott

- Facilitated weekly tutorials on groundwater modeling using OpenGeoSys, helping students with problem solving, input file creation and debugging

Topical Themes in GeoEngineering: Dr Chris McDermott

- Facilitated weekly tutorials on regional groundwater flow modelling within various geoengineering scenarios using OpenGeoSys

Computational Simulation of Groundwater Flow: Dr. Ian Molnar

- Facilitated weekly tutorials on creating a groundwater flow numerical model using Python
- Assisted students after hours with code debugging

Environmental Site Assessment Project: Dr. Ian Molnar

- Led weekly tutorials on writing an environmental site assessment report including numerical modeling in Visual MODFLOW and desktop investigation
- Assisted with field work consisting of site characterization, water level readings, slug tests and pump test*s*

Teaching Assistant, Queen's University, Department of Civil Engineering *2018 – 2020*

Subsurface Contamination: Dr. Bernard Kueper

- Graded multiple student assignments for class of 80 students
- Delivered weekly hour-long problem-based tutorials on subsurface contamination

Groundwater Engineering: Dr. Kevin Mumford

- Graded student assignments and laboratory reports for class of 100 students
- Assisted in laboratory exercises on groundwater flow using bench-scale groundwater models
- Developed and marked mid-term examinations
- Facilitated weekly problem-based tutorials, assisting students as needed

Numerical Methods: Dr. Robert Cichoki

- Led weekly tutorials on computational and numerical methods for civil and environmental engineering students using MATLAB
- Graded student assignments and laboratory reports for class of 100 students

Chemistry for Civil Engineers: Dr. Kevin Mumford

- Developed and produced remote course delivery for laboratory exercises
- Led weekly online problem-based tutorials, adapting to COVID-19 online teaching requirements

Employment

Environmental Consultant, GSI Environmental, Austin TX *2020-2021*

- Developed software package (DE-GAS Toolkit, available online) for characterization and interpretation of dissolved gas data using Visual Basic
- Monitored fugitive gas migration from leaking gas wells in the Marcellus shale through analysis dissolve gas and isotope data
- Reviewed and contributed to major progress reports for clients

Intern Environmental Engineer, GSI Environmental, Austin TX *2019*

- Contributed to environmental remediation projects such as enhanced delivery of remedial amendments for chlorinated solvents in groundwater and quantifying methane emissions from oil and gas wells
- Worked with regulatory framework (US EPA, Texas CEQ) and am comfortable teaching hydrogeologists to work within such frameworks

Additional skills and courses

Field Methods in Hydrogeology, University of Waterloo *(2019)* – 3-week graduate course on the theory and applications of field techniques in hydrogeology, including conducting a 24-hour pump test and processing data sets from field work

Carbon Capture Utilisation and Storage Summer School, TU Delft *(2022)* – 5-day school covering basics of carbon capture, utilisation and storage in the subsurface, including multi-phase flow in reservoirs

Science Communication for the Geosciences Workshop, SAGES *(2024)* – 2-day workshop on communicating and promoting research

Highly proficient coding skills in MATLAB, Python, C++ for scientific computing

Numerical modeling experience in OpenGeoSys, MODFLOW, MIN3P

Awards

Postgraduate Research Conference, University of Edinburgh, School of Geosciences

- Best Presentation, Earth and Planetary Sciences *2022*

Natural Environment Research Council

- Edinburgh Earth Ecology and Environment Doctoral Training Partnership *2021-2025*

Natural Sciences and Engineering Research Council of Canada

- Alexander G. Bell Canada Graduate Scholar *2018*
- Undergraduate Student Research Award (Western University) *2016, 2017*

School of Graduate Studies, Queen's University

- Ontario Graduate Scholarship *2019*
- Tri-Council Recipient Recognition Award *2018*

Faculty of Engineering and Applied Science, Queen's University

- William Wallace Near Scholarship *2016*
- Dean's Honours *2015 - 2018*
- Principal's Scholarship *2014, 2015*

Administration Experience

Scottish Carbon Capture and Storage, Edinburgh Climate Change Institute *2022*

- Organized SCCS Annual Conference 2022 and associated PhD Consortium Launch
- Communicated with all invited speakers and prepared speaker biographies
- Co-authored conference briefing covering the formalisation of CCS implementation in UK and EU regulations, Article 6 of the Paris Agreement, and the current state of CCS.

Conferences

Presentation: *A coupled discrete-continuum approach to simulating CO_2 migration and dissolution in porous media*. EGU General Assembly, Vienna, AUT, April 2024

Presentation: *ET-MIP: Predicting fate and transport of CO_2 in overburden at the field scale.*
SIAM Conference on Mathematical & Computational Issues in the Geosciences, Bergen, NO, June 2023.

Presentation: *ET-MIP: A coupled model approach to simulating the fate and transport of CO_2 in overburden*. InterPore 2023 International Conference on Porous Media, Edinburgh, UK, May 2023.

Presentation: *Predicting the fate and migration of CO_2 in carbon storage reservoir overburden.*
Postgraduate Research Conference, University of Edinburgh, School of Geosciences, May 2022.

Referees

Dr. Ian Molnar, School of Geosciences, University of Edinburgh, ian.molnar@ed.ac.uk
Dr. Stuart Gilfillan, School of Geosciences, University of Edinburgh, stuart.gilfillan@ed.ac.uk
Dr. Kevin Mumford, Department of Civil Engineering, Queen's University, kevin.mumford@queensu.ca
Dr. Lisa Molofsky, GSI Environmental, Houston TX, lmolofsky@gsi-net.com