Ph.D. Candidate

Magda Agata Celejewski

Graduate Academic Unit

Earth Sciences

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November 25, 2022

2:00 p.m. (Atlantic)

Virtual Defence

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Examining Board:
Dr. Chris McFarlane (Earth Sciences)
Dr. Karl Butler (Earth Sciences)
Dr. Kerry MacQuarrie (Civil Engineering)
Dr. Allison Enright (Earth Sciences) Supervisor
Dr. Tom Al (Earth and Environmental Sciences, uOttawa) Supervisor

External Examiner: Dr. Grant Ferguson
Civil, Geological and Environmental Engineering
University of Saskatchewan

The Oral Examination will be chaired by:
Dr. Kevin Englehart, Associate Dean of Graduate Studies

BIOGRAPHY

Universities attended (with dates & degrees obtained):

2011 – present	Ph.D. candidate, University of New Brunswick
2010	M.Env.Sci., Environmental Science, University of Toronto
2008	B.Sc. in Chemistry and Environmental Science, University of Toronto

Selected Publications:

Celejewski, M., Barton, D., Al, T. 2018, Measurement of Cl^-: Br^- Ratios in the Porewater of Clay-Rich Rocks - A comparison of the Crush-and-Leach and the Paper-Absorption methods. Geofluids, 2018.

Mazurek, M., Al, T., **Celejewski, M.**, Clark, I. D., Fernandez, A. M., Jaeggi, D., Kennell-Morrison, L., Matray, J. M., Murseli, S., Oyama, T., Qiu, S., Rufer, D., St-Jean, G., Waber, H. N., and Yu, and C. 2017, Mont Terri DB-A Experiment: Comparison of Pore-water Investigations Conducted by Several Research Groups on Core Materials from the BDB-1 Borehole. NWMO-TR-2017-09.

Celejewski, M., Scott, L., Al, T. 2014, An absorption method for extraction and characterization of porewater from low-permeability rocks using cellulosic sheets. Applied Geochemistry, 49, 22-30.

McKelvie, J.R., Åslund, M.W, **Celejewski, M.,** Simpson, A.J., Simpson, M.J. 2013, Reduction in the earthworm metabolomic response afte phenanthrene exposure in soils with high soil organic carbon content. Environmental Pollution, 175, 75-81

McKelvie, J.R., Wolfe, D., **Celejewski, M**., Alaee, M., Simpson, A.J., and Simpson, M.J. 2011, Metabolic responses of Esenia fetida after sub-lethal exposure to organic contaminants with different toxic modes of action. Environmental Pollution, 159, 12, 3620-3626

Selected Conference Presentations:

Celejewski, M., Clark, I., Al, T., A comparison of porewater natural tracers in low-permeability sedimentary rocks characterized using two methods Euroclay, Edinburgh, UK, July 5-10, 2015. (Presentation)

Celejewski, M., Clark, I., Al, T., Method and Development. NWMO Geoscience Seminar, Blue Mountain Resort, ON, June 1-2, 2015. (Poster)

Celejewski, M., Clark, I., Al, T., A novel method for extraction and characterization of porewater from low-permeability sedimentary rocks. GAC-AGU, Montreal, QC, May 3-7, 2015. (Presentation)

Celejewski, M., Clark, I., Al, T., A new method for extraction and characterization of porewater from low-permeability sedimentary rocks. 6th International Clay Conference, Brussels, Belgium, March 23-26, 2015. (Presentation)

Celejewski, M., Clark, I., Al, T., A new method for characterization of porewater chemistry in low-permeability sedimentary rocks, AGU Fall Meeting, San Francisco, CA, December 14-19, 2014. (Poster)

Porewater characterization in low-permeability rock samples using a novel extraction method

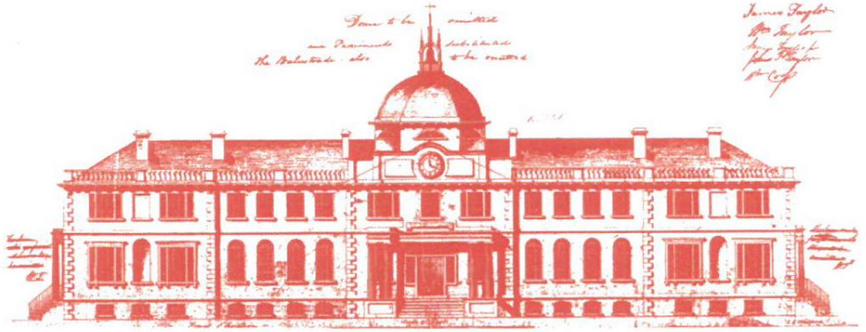
Abstract

Characterization of porewater chemistry in low-permeability sedimentary deposits provides insights into solute transport mechanisms and the origin and residence time of fluids. Recent interest in solute transport through low-permeability rocks defined by low hydraulic conductivity (<10−11 m/s) and diffusion dominated solute transport has been prompted by requirements for long-term geological sequestration of CO2 and isolation of various waste forms, including nuclear waste. Additionally, development of landslide potential in sensitive marine muds with low hydraulic conductivity is dependent on solute distribution through the deposit. However, representative sampling of porewater from materials with low permeability and small porewater volumes remains a challenge. The main objective of this thesis is to develop and establish a novel method for extraction and characterization of in-situ porewater by capillarity and diffusion, targeting only the water in the most interconnected pore spaces. This method uses a cellulose-based material with a low chemical background and exhibiting no preferential sorption of major porewater solutes.

The feasibility of porewater extraction by this cellulosic material from sediments and rocks with low hydraulic conductivity is demonstrated on samples from the Opalinus Clay, Switzerland, the Upper Ordovician Lorraine Group shale, Quebec, the Upper Ordovician shales, the Michigan Basin in Ontario, and the Champlain Sea mud, Ontario. Results of Cl− and Br− masses obtained by the paper absorption method from shale and clay-rocks produce systematically lower Cl− : Br− ratios than those from a crush-and-leach method. The magnitude of the difference in Cl− : Br− ratios is inversely related to pore throat diameters, and is attributed to size-specific anion exclusion effects.

A benchmarking experiment conducted on Champlain Sea mud demonstrated that porewater solute concentrations measured in paper-absorption and centrifuge extracts compare well. However, alkaline-earth metal concentrations are systematically lower in porewater extracted by the paper absorption method, indicating potential sorption to the absorbing paper or fractionation during centrifugation.

The results of this work highlight the fact that different porewater extraction methods yield different proportions of porewater from the mobile and bound fractions. As such, understanding the unique characteristics or biases of each method is important when assessing solute distribution and transport.



Home of the School of Graduate Studies, Sir Howard Douglas Hall was designed by J.E. Woolford in 1825 and is the oldest university building in Canada still in use.

The University of New Brunswick recognizes that the university sits on traditional Wolastoqey territory. The river that runs right by our university – the St. John River – is also known as Wolastoq, along which live the Wolastoqiyik -- the people of the beautiful and bountiful river.

UNIVERSITY OF NEW BRUNSWICK

SCHOOL OF GRADUATE STUDIES

ORAL EXAMINATION

Magda Agata Celejewski

IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY