Ph.D. Candidate

Sarah Speight

Graduate Academic Unit

Earth Sciences

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January 27, 2023

2:30 p.m. (Atlantic)

Virtual Defence

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Examining Board:
Dr. Cliff Shaw (Earth Sciences)
Dr. Joseph White (Earth Sciences)
Dr. Sara Eisler (Chemistry)
Dr. Jacob Hanley (ESCI Adjunct) Co-Supervisor
Dr. Chris McFarlane (Earth Sciences) Supervisor

External Examiner: Dr. Andrew Conly
Department of Geology
Lakehead University

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

BIOGRAPHY

Universities attended (with dates & degrees obtained):

2016 – present	Ph.D. candidate, University of New Brunswick
2013	Master of Science, Laurentian University
2011	Bachelor of Science with Honours in Geology, University of New Brunswick

Publications:

Gordon, S.C., and McDonald, A.M. (2015) A study of the composition, distribution and genesis of pyrrhotite in the Copper Cliff Offset, Sudbury, Ontario. The Canadian Mineralogist. 53: 859-878.

Selected Conference Presentations:

Speight, S.C., Hanley, J.J., MacFarlane, C.R.M. (2022) A preliminary investigation of zircon-hosted melt and mineral inclusions from intermediate and felsic intrusions within the Yellowknife greenstone belt, NWT, Canada. GAC-MAC-IAH-CNC-CSPG Joint Meeting.

Speight, S.C., Hanley, J.J., McFarlane, C.R.M. (2021) Geodynamic evolution of felsic magmatism in the Yellowknife greenstone belt: evidence for Archean magmatism in a volatile-saturated environment. (Ph.D.)

Speight, S.C., Hanley, J.J., McFarlane, C.R.M. (2021) The geochemical evolution of felsic magmatic intrusions in the Yellowknife greenstone belt, NWT: identifying adakites in the Archean. PDAC Student Colloquium. (Ph.D)

Speight, S.C., McFarlane, C.R.M., Hanley, J.J. (2019) Evidence for sulfur saturation from zircon-hosted melt inclusions in felsic plutons and dikes of the Yellowknife greenstone belt, NWT. GAC-MAC Conference. (Ph.D)

Speight, S.C., McFarlane, C.R.M., Hanley, J.J. (2019) New U-Pb ages and compositional data from zircons to establish the timing and evolution of porphyritic intrusions and plutonic bodies in the Yellowknife greenstone belt, NWT. GAC-MAC-IAH Conference. (Ph.D)

Speight, S.C.*, Lentz, D.R., McFarlane, C.R.M. (2018) Petrographic analysis of syn- to post-tectonic granitic dykes in the Yellowknife greenstone belt, NWT: evidence for late-stage H_2O-rich fluids. Yellowknife Geosciences Forum. (Ph.D)

Speight, S.C., Lentz, D.R., McFarlane, C.R.M. (2018) New insights into barren and Au-mineralized intrusions using whole-rock and trace element geochemistry from the Yellowknife greenstone belt, NWT. Yellowknife Geosciences Forum. (Ph.D)

Speight, S.C., Lentz, D.R., McFarlane, C.R.M. (2018) In-situ trace element analysis of quartz phenocrysts from porphyritic intrusions in the Yellowknife greenstone belt, NWT. Resources for Future Generations Conference. (Ph.D)

Speight, S.C.,** Lentz, D.R., McFarlane, C.R.M. (2018) SEM-Cathodoluminescence imaging and analysis of quartz phenocrysts and phenoclasts from porphyritic intrusions in the Yellowknife greenstone belt, NWT. (Ph.D)

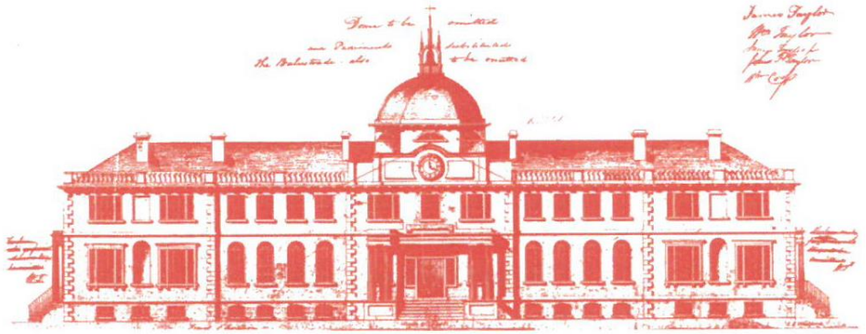
Assembling an Archean magmatic plumbing system: geochemical evolution, emplacement, and metallogenic implications of subvolcanic intrusions in the Yellowknife greenstone belt, N.W.T., Canada

Abstract

The Yellowknife greenstone belt (YGB), located in the Archean Slave Province in the Northwest Territories, Canada, consists of mafic and felsic metavolcanic sequences intruded by dikes and regional plutons. The locally known "#9" dikes comprise three generations of intrusions that were not geochemically differentiated or genetically linked to a parental source, including, feldspar-quartz porphyry (FQP), quartz porphyry (QZP), and aplite dikes. Despite the spatial association with mineralization and inferred relationship to overlying volcaniclastic units, the dikes remain poorly understood. Therefore, a multi-analytical approach was needed to characterize the evolution, emplacement, and metallogenic signature of YGB magmatism.

The lithogeochemical signatures of the dikes, combined with U-Pb zircon geochronology, differentiated them into three groups: 1) the Ryan Lake Pluton (RLP), represented by tonalites (2662 Ma) and granodiorites (2647 Ma), and the FQP (2674 – 2662 Ma) and aplite-1(a) dikes (2663 Ma); 2) the Defeat Suite granite (2580 Ma) and aplite-1(b) dikes (2662 Ma); and 3) the Duckfish granite (2576 Ma) and the aplite-2 dikes (ca. 2611 Ma). The intrusions were also compared to the overlying felsic volcaniclastics of the Townsite Formation and Banting Group. When combined with field observations, this confirms that only the FQP dikes are subvolcanic feeders to these units. The ambiguous lithogeochemistry of the QZP dikes (2770 Ma) and the age gap with the main diking event (ca. 2662 Ma) did not allow for a plutonic connection. Rather, the QZP and one FQP dike proximal to the Duckfish granite may reflect magmatism related to the Central Slave Basement Complex. Additionally, macro- and micro-scale textural analysis of the aplite dikes provided evidence of emplacement during crystallization of the parental magmas. The three groups of aplite dikes (1(a), 1(b), and 2) commonly have quartz cores and discontinuous quartz pods at the outcrop scale that reflect crystallization from a volatile-saturated melt.

Finally, analysis of zircon-hosted melt inclusions (MI) from a subset of YGB dikes and plutons showed evidence of early precious metal-enrichment. Careful data filtering to remove contaminated inclusions produced the first MI dataset from the Archean YGB which represents primary silicate melts. Zircon-hosted MI that contain accidentally trapped phases also provide valuable information, despite the semi-quantitative nature of the data. These mixed MI provide direct evidence of Ti- and H_2O-saturation through the presence of (Fe)-Ti-oxides and hydrous minerals (e.g., biotite, amphibole). This preliminary work establishes that critical information related to primary metal signatures in the YGB can be obtained from Archean MI.



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

Sarah Speight

IN PARTIAL FULFILMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY