Vita

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Universities Attended:

University of New Brunswick (2018)
Bachelors of Science Honours
Earth Science

University of New Brunswick (2020)
Masters of Science
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<u>Conferences:</u>

Richardson M. W., McFarlane, C.R.M., and Lentz, D.R. (2019). U-Pb LA-ICP-MS apatite age and characterization of Archean auriferous quartz veins of the Ptarmigan and Tom gold deposits, Yellowknife, Northwest Territories. GAC-MAC Annual Meeting, Quebec City.

Richardson, M. W., and Lentz, D.R. (2019). Characterization of auriferous quartz veins of the Ptarmigan and Tom gold deposits, Yellowknife, Northwest Territories, Canada. In: 55^{th} Atlantic Geoscience Society Abstracts – 45^{th} Colloquium, Fredericton, New Brunswick. Abstracts v. 2019.

Richardson, M. W., and Lentz, D.R. (2018). Structural analysis and characterization of auriferous quartz veins of the Ptarmigan and Tom gold deposits, Yellowknife, Northwest Territories. In: 46^{th} Annual Yellowknife Geoscience Forum Abstracts, Northwest Territories Geological Survey, Yellowknife, NWT. v. 2018.

Controls on Genesis, Distribution, and Nature of the Turbidite-hosted Gold Deposits, Eastbelt, Southwestern Slave Structural Province, Yellowknife, Northwest Territories

UNIVERSITY OF NEW BRUNSWICK

THESIS DEFENCE AND EXAMINATION

in Partial Fulfillment

of the Requirement for the Degree of
Master of Science

by

Mark Wesley Richardson

in the Department of Earth Science

U.N.B., Fredericton, N.B.

Friday, May 22^{nd}, 2020
10:00 a.m.

Via TEAMS

Examining Committee

Dr. David Lentz	Co-Supervisor
Dr. Chris McFarlane	Internal Examiner
Dr. Bryan Crawford	External Examiner
Dr. Joseph C. White	Chair of Oral Examination

Abstract

The Ptarmigan and Tom mesothermal gold deposits are located 10 km to the northeast of the city of Yellowknife, Northwest Territories. Both gold deposits comprise a series of *en echelon* veins. These veins are hosted within upper greenschist to lower amphibolite facies ~2630 Ma rocks. A low-temperature reduced hydrothermal environment during ore deposition formed as either a part of the main arsenopyrite-dominated mineralization or a distinct late-stage ore-formation event. At the deposit scale, the high-grade gold ores are preferentially developed with three contextual scenarios: (1) along contacts, especially the contact between black siltstone host rock and major barren, cleavage-parallel veins; (2) the contact between quartz laminae and carbonaceous host rock slivers; (3) proximity to bismuth telluride mineralization. Thus, competent, barren quartz veins along the axial plane of fold/thrust belts locally host superimposed gold mineralization and provide favourable targets for gold exploration

Hydrothermal apatite is a common accessory mineral in both mineralized and non-mineralized quartz veins in the metasedimentary host rocks that constitute the Ptarmigan and Tom deposits. The apatite in this study likely formed coeval with early stages of sulphide precipitation. The apatite age of 2585 ± 15 Ma is consistent with the intrusions of the 2605 and 2590 Ma two-mica granites of the Prosperous Suite. The near-concordant 204Pb-corrected data of the LCT pegmatite hosted apatite reveals two clusters of ages. An older population with an intercept age (N = 4) of 2581 ± 15 Ma, and a younger population with an intercept age (N = 3) of 2519 ± 12 Ma . Furthermore, plotting a regression through all near – concordant data for the pegmatite hosted apatite hints that metamorpic resetting occured around ~2200 Ma.

The distribution and abundance of major, minor, and trace elements from *in-situ* recovered apatite were studied to characterize the nature of mineralizing fluids. Most apatite from mineralized and non-mineralized veins show different Mn, Sr, and Pb contents, as well as chondrite-normalized rare-earth element (REE) and Y abundance patterns. REEs display five unique chondrite-normalized patterns: (1) negative sloped pattern with slight negative Eu anomaly, (2) a flat pattern with a positive Eu anomaly, (3) a positive slope with a negative Eu anomaly, (iv) light rare earth element (LREE) depleted pattern with positive Eu anomaly, and (v) bell-shaped pattern with a negative Eu anomaly. The REE patterns likely reflect both the source of the auriferous hydrothermal fluids and, perhaps, co-precipitating mineral phases. Apatite from the Ptarmigan vein occurs with both: (1) a flat pattern with a positive Eu anomaly and (2) bell-shaped pattern with a negative Eu anomaly. The bell-shaped and flat patterns typify orogenic gold deposits. Vein-hosted apatite commonly displays compositional zoning with a characteristic yellow cathodoluminescence (CL) emission spectra with darker cores and brighter rims. The cores have lower REE, whereas the rims are notably REE higher. It is thought that the darker cores in CL images reflect a transition from an early low REE hydrothermal fluid to one enriched in REE. Lastly, this study breaks ground for conducting a more robust study to classify the trace-element composition of apatite in gold deposits worldwide.