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A NEOPROTEROZOIC AGE FOR GRANODIORITE UNDERLYING ROGERSON LAKE CONGLOMERATE: CONFIRMED GANDERIAN BASEMENT IN THE WILDING LAKE AREA, CENTRAL NEWFOUNDLAND GOLD DISTRICT

I.W. Honsberger, W. Bleeker, S.L. Kamo, D.T.W. Evans and H.A.I. Sandeman

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NOTE

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ABSTRACT

We report a high-precision CA-ID-TIMS U–Pb zircon crystallization age of 565.0 ± 2.3 Ma for a previously undated granodiorite sample from drillcore on Antler Gold's Wilding Lake property in central Newfoundland. The timing of the granodiorite intrusion overlaps, within error, the emplacement of magmatic rocks of the Neoproterozoic Crippleback Intrusive Suite, including the gold-mineralized Valentine Lake pluton. Such a correlation confirms that the highly prospective crustal-scale Valentine Lake fault zone, and its northeastern extension, cuts Ganderian basement, and further highlights similarities along strike between the Valentine Lake and Wilding Lake areas.

INTRODUCTION AND GEOLOGICAL CONTEXT

The structurally controlled gold district of central Newfoundland, trending northeast between the Cape Ray fault in southwestern Newfoundland and the Dog Bay line in the eastern Dunnage Zone (Figure 1), is a region of active exploration and geological research due to its emerging economic resource potential. The recent success of Marathon Gold Corp.'s Valentine Lake project, now reporting a total measured and indicated resource of 2 691 400 oz gold and an inferred gold resource of 1 531 600 oz (Marathon Gold Corp., corporate presentation, October 30th, 2018), is evidence of the district's high prospectivity and has stimulated renewed prospecting and exploration along the structural corridor. Gold mineralization at Valentine Lake is associated with stacked *en échelon* extensional quartz veins that cut trondhjemite, quartz monzonite and minor gabbro of the Neoproterozoic Valentine Lake pluton (563 ± 2 Ma; Evans *et al.*, 1990) in the structural hangingwall of the Valentine Lake fault zone. The latter represents an over-steepened, oblique left-lateral reverse shear zone that buries and truncates deformed Silurian Rogerson Lake Conglomerate in its footwall (Lycopodium Minerals Canada Ltd., 2018).

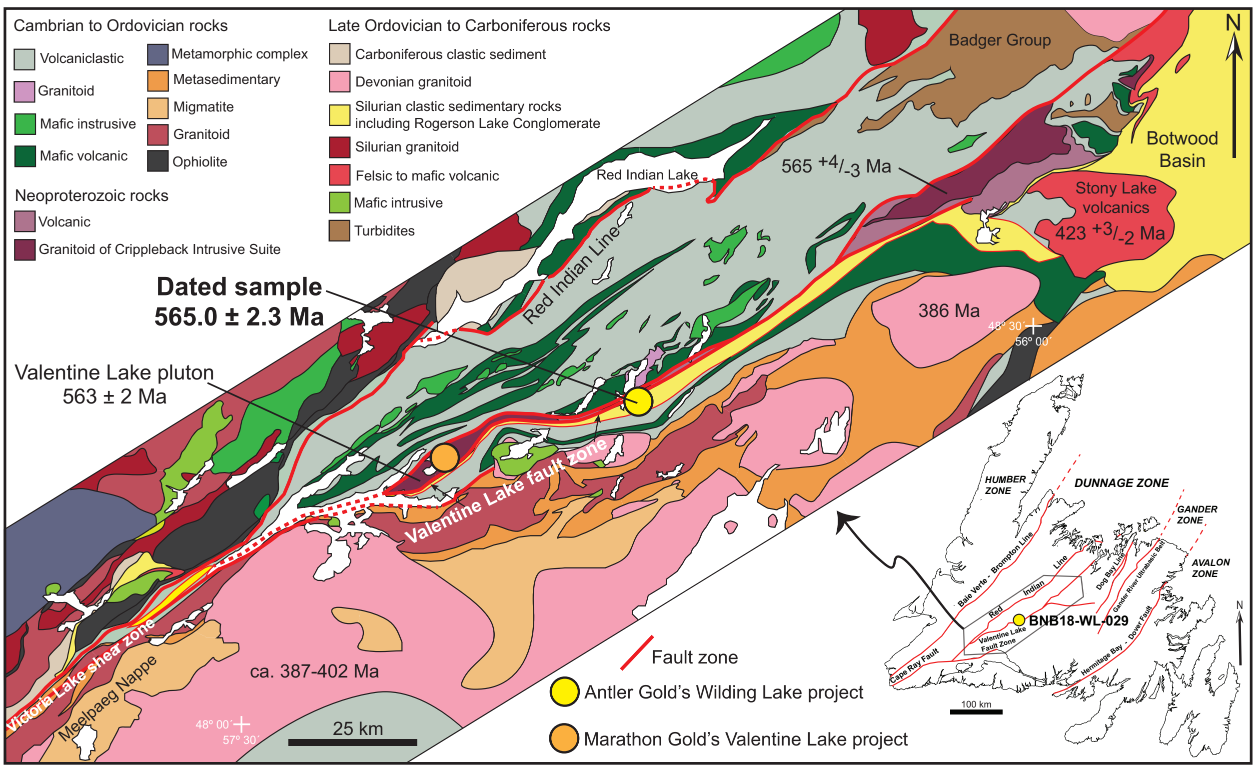

Figure 1. *Generalized geological map of the central Newfoundland gold district showing major fault zones (red lines) and the locations of Marathon Gold Corp.'s Valentine Lake (orange circle) and Antler Gold Inc.'s Wilding Lake (yellow circle) projects. The inset is a generalized map of the Island of Newfoundland showing crustal-scale fault zones and distribution of major tectonostratigraphic zones (modified from Williams (1978) and Colman-Sadd* et al. *(1990)). Gold in the Valentine Lake and Wilding Lake areas is associated with the structural corridor defined by Silurian clastic sedimentary rocks, including the Rogerson Lake Conglomerate. Ages for the Neoproterozoic Crippleback Intrusive Suite (maroon) from Evans* et al. *(1990), Stony Lake volcanics (Dunning* et al.*, 1990; McNicoll* et al.*, 2008), and Devonian granitoids (Valverde-Vaquero* et al.*, 2006). The drillcore sample analyzed in this study is BNB18-WL-029.*

Approximately 40 km northeast along strike, in the structural footwall of the Valentine Lake fault zone at Wilding Lake, Antler Gold Inc. recently uncovered high-grade, shear vein-hosted gold mineralization in the Rogerson Lake Conglomerate (Alder and Elm zones) and lower grade disseminated gold mineralization in feldspar porphyry (Red Ochre Zone) (Figure 2; Antler Gold Inc., press release, January 24th, 2017; Honsberger *et al.*, 2019a, b). A 300 m-long vertical drill-hole (WL-17-29) testing a ~1.0 km-wide, northeast-trending magnetic anomaly underlying the

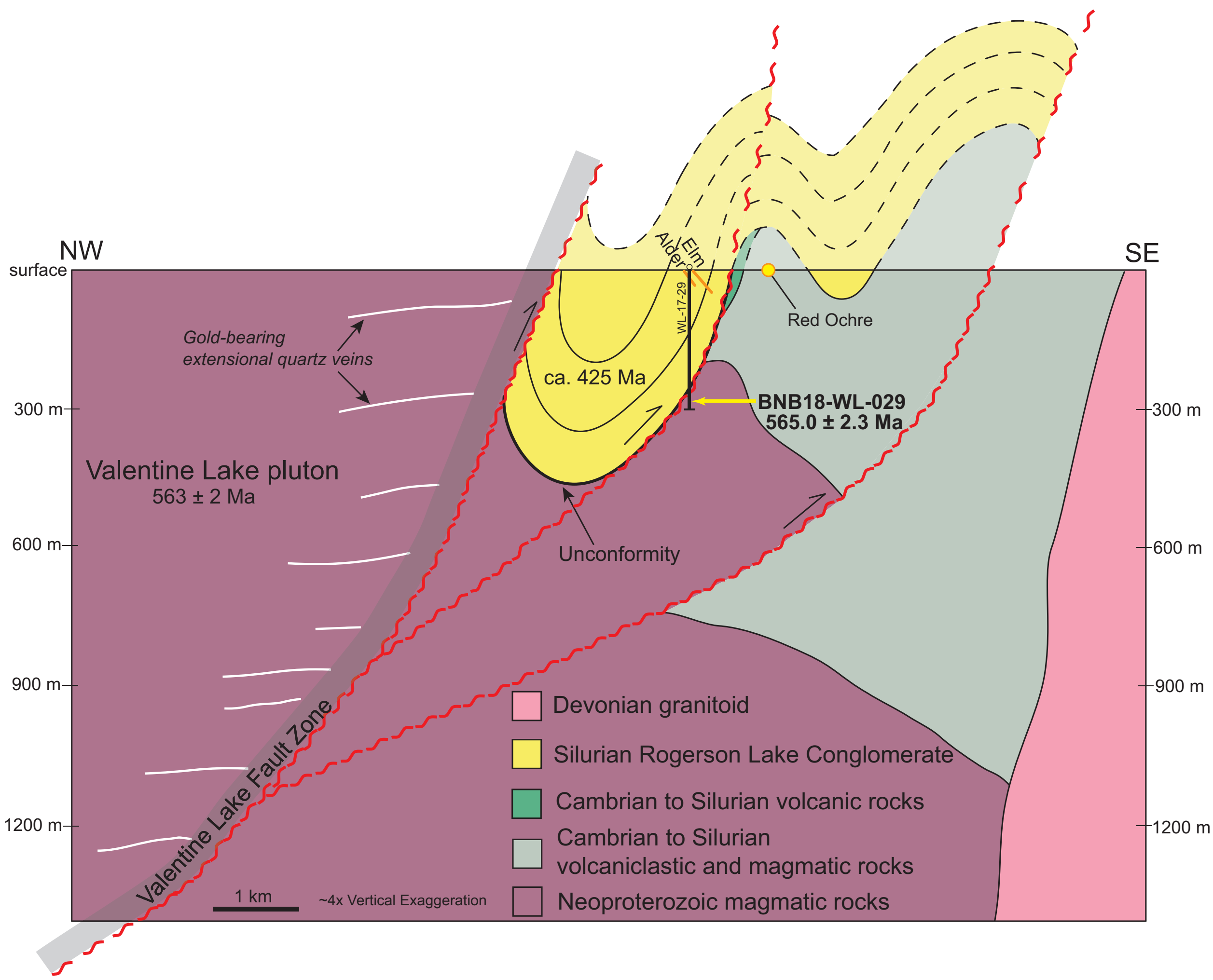

Figure 2. *Interpreted composite cross-section representing ~40-km strike length along the Valentine Lake fault corridor between Valentine Lake and Wilding Lake. The cross-section illustrates structural hangingwall rocks of the Valentine Lake pluton above footwall rocks at Wilding Lake, which consist of Ganderian basement underlying Rogerson Lake Conglomerate and Cambrian to Silurian volcanic and volcaniclastic rocks. Antler Gold's Alder and Elm zones (orange lines) preserve shear vein-hosted gold mineralization in Rogerson Lake Conglomerate, whereas the Red Ochre Zone preserves disseminated mineralization in feldspar porphyry. Geochronology drillcore sample BNB18-WL-029 was collected between 296–290 m depth along Antler Gold Inc.'s vertical drillhole WL-17-29. Gold mineralization at Valentine Lake occurs in extensional quartz veins within the hangingwall of the Valentine Lake fault zone (shown schematically). The gabbro– tonalite–granodiorite body underlying Antler Gold Inc.'s Wilding Lake property has not been explored beyond 300 m depth.*

gold-bearing structural corridor at Wilding Lake revealed that a medium-grained granodiorite unit occurs unconformably below the Rogerson Lake Conglomerate (Figure 2; Antler Gold Inc., press release, December 13th, 2017).

U–PB ZIRCON GEOCHRONOLOGY

Three single zircon grains from granodiorite sample BNB18-WL-029 were dated using standard methods and analyzed *via* chemical abrasion–isotope dilution–thermal ionization mass spectrometry (CA-ID-TIMS) at the Jack Satterly Geochronology Laboratory, University of Toronto. Age calculations were performed using ISOPLOT (Ludwig, 2008). U–Pb geochronological data and analytical notes are presented in Table 1.

RESULTS: SAMPLE BNB18-WL-029

Sample BNB18-WL-029 is a moderately deformed, medium-grained, grey granodiorite collected between 296–290 m depth from Antler Gold's 2017 vertical drillhole WL-17-29 (Figures 2 and 3A). The sample was collected from immediately beneath a sheared contact with the overlying Rogerson Lake Conglomerate that displays disseminated pyrite, chalcopyrite, and gold mineralization.

Results for two perfectly concordant zircon grains from BNB18-WL-029 yield a weighted mean $^{207}Pb/^{206}Pb$ age of 565.0 ± 2.3 Ma (uncertainty at the 95% confidence interval, MSWD = 0.31), which is interpreted as the crystallization age of the granodiorite sample (Table 1; Figure 3B). One highly discordant grain may reflect Cambrian or Devonian Pb loss or alternatively metamorphic zircon growth (Figure 3B), a question that may be resolved by additional analyses of zircon grains.

GEOLOGICAL AND EXPLORATION IMPLICATIONS

High precision CA-ID-TIMS U–Pb zircon geochronology constrains the crystallization age of a previously undated granodiorite body in the footwall of the Valentine Lake fault zone, at Wilding Lake, to 565.0 ± 2.3 Ma, the same age, within error, as hangingwall rocks of the Neoproterozoic Valentine Lake pluton (563 ± 2 Ma) and Crippleback Lake quartz monzonite (565 $^{+4}/_{-3}$ Ma; Evans *et al.*, 1990). This new result, from multiple, chemically abraded, single zircon crystals, demonstrates that Neoproterozoic Ganderian basement, not a Cambrian to Silurian magmatic-sedimentary terrane (*e.g.*, Honsberger *et al.*, 2019b), underlies the Silurian Rogerson Lake Conglomerate at Wilding Lake. The crustal-scale Valentine Lake fault zone, therefore, cuts across Neoproterozoic Ganderian (*e.g.*, Rogers *et al.*, 2006) basement, which may have implications for footwall gold mineralization at depth (>300 m) beneath Rogerson Lake Conglomerate in central Newfoundland. Such a style of structurally controlled footwall mineralization closely resembles the setting of world-class Archean gold deposits in the Archean Abitibi greenstone belt (Bleeker, 2015; Honsberger and Bleeker, 2018). Accordingly, the ~1.0 km-wide, northeasterly-trending magnetic anomaly that traces the granodiorite body beneath Silurian Rogerson Lake Conglomerate on Antler Gold's Wilding Lake property may be a promising, rheologically brittle and rigid host-rock target for future gold exploration.

Table 1. U–Pb geochronological data for zircons from sample BNB18-WL-029 using the CA-ID-TIMS method

Analysis No.	Weight (μg)	U (ppm)	Th/U	Pbc (pg)	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{235}U$	2σ	$^{206}Pb/^{238}U$	2σ	Error Corr.	$^{207}Pb/^{206}Pb$	2σ	Age (Ma) $^{206}Pb/^{238}U$	2σ	$^{207}Pb/^{235}U$	2σ	$^{207}Pb/^{206}Pb$	2σ	% Disc.
BNB18-WL-029: Granodiorite below Rogerson Lake Conglomerate																			
Location: Diamond drill hole WL-029, 517453.00 m E, 5367934.00 m N, Zone 21 U																			
Zr1	21.5	115	0.71	0.62	23327	0.74388	0.00158	0.091500	0.000097	0.663	0.058963	0.000096	564.40	0.57	564.7	0.9	565.7	3.5	0.2
Zr2	16.2	121	0.88	0.67	17305	0.74249	0.00145	0.091385	0.000091	0.705	0.058928	0.000084	563.72	0.53	563.9	0.8	564.4	3.1	0.1
Zr3	19.6	12	0.19	0.42	2893	0.66817	0.00148	0.083518	0.000083	0.706	0.058024	0.000097	517.09	0.49	519.6	0.9	530.7	3.7	2.7

Notes:
Single zircon grains (Zr) have been thermally annealed and etched in HF (Mattinson, 2005).
Th/U calculated from radiogenic $^{208}Pb/^{206}Pb$ ratio and $^{207}Pb/^{206}Pb$ age, assuming concordance.
Pbc is total common Pb, assuming the isotopic composition of laboratory blank ($^{206}Pb/^{204}Pb$=18.49 ± 0.4%; $^{207}Pb/^{204}Pb$=15.59 ± 0.4%; $^{208}Pb/^{204}Pb$=39.36 ± 0.4%).
$^{206}Pb/^{204}Pb$ corrected for fractionation and common Pb in the spike.
Pb/U ratios corrected for fractionation, common Pb in the spike, and blank.
Correction for ^{230}Th disequilibrium in $^{206}Pb/^{238}U$ and $^{207}Pb/^{206}Pb$ assuming Th/U of 4.2 in the magma.
Disc. is percent discordance for the given $^{207}Pb/^{206}Pb$ age.
Error Corr. is correlation coefficients of X-Y errors on the concordia plot.
Decay constants are those of Jaffey *et al.* (1971): ^{238}U and ^{235}U are 1.55125 X 10^{-10}/yr and 9.8485 X 10^{-10}/yr.
$^{238}U/^{235}U$ ratio of 137.88 used for $^{207}Pb/^{206}Pb$ model age calculations.

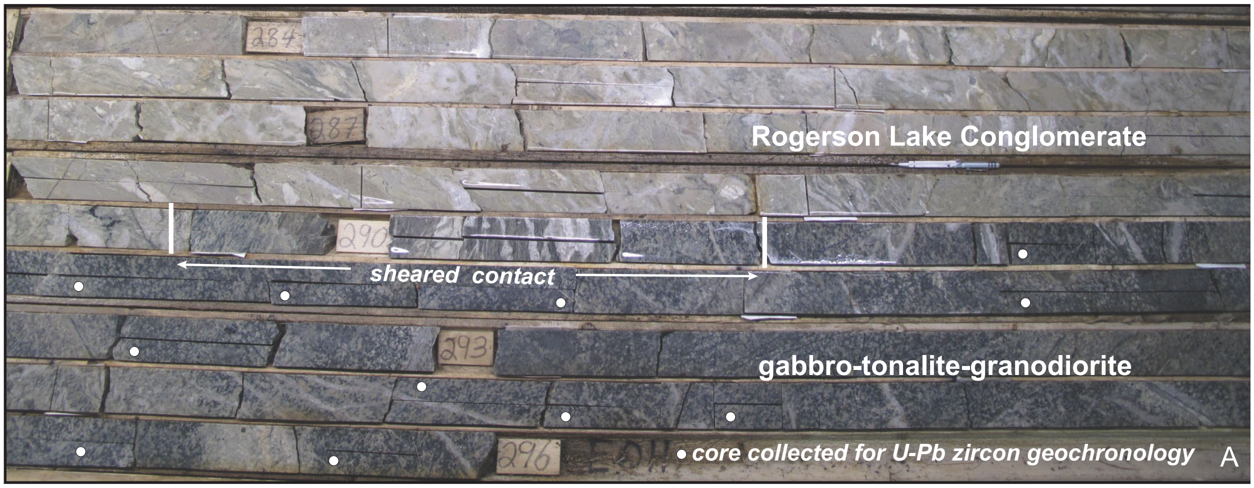

Figure 3A. *Core WL-17-29 between 296–284 m depth (marked in 3 m intervals). BNB18-WL-029 consisted of drillcore pieces that were least affected by crosscutting quartz veins (marked by white circles), and occurred below the sheared contact (between vertical white lines) with altered and mineralized Rogerson Lake Conglomerate.*

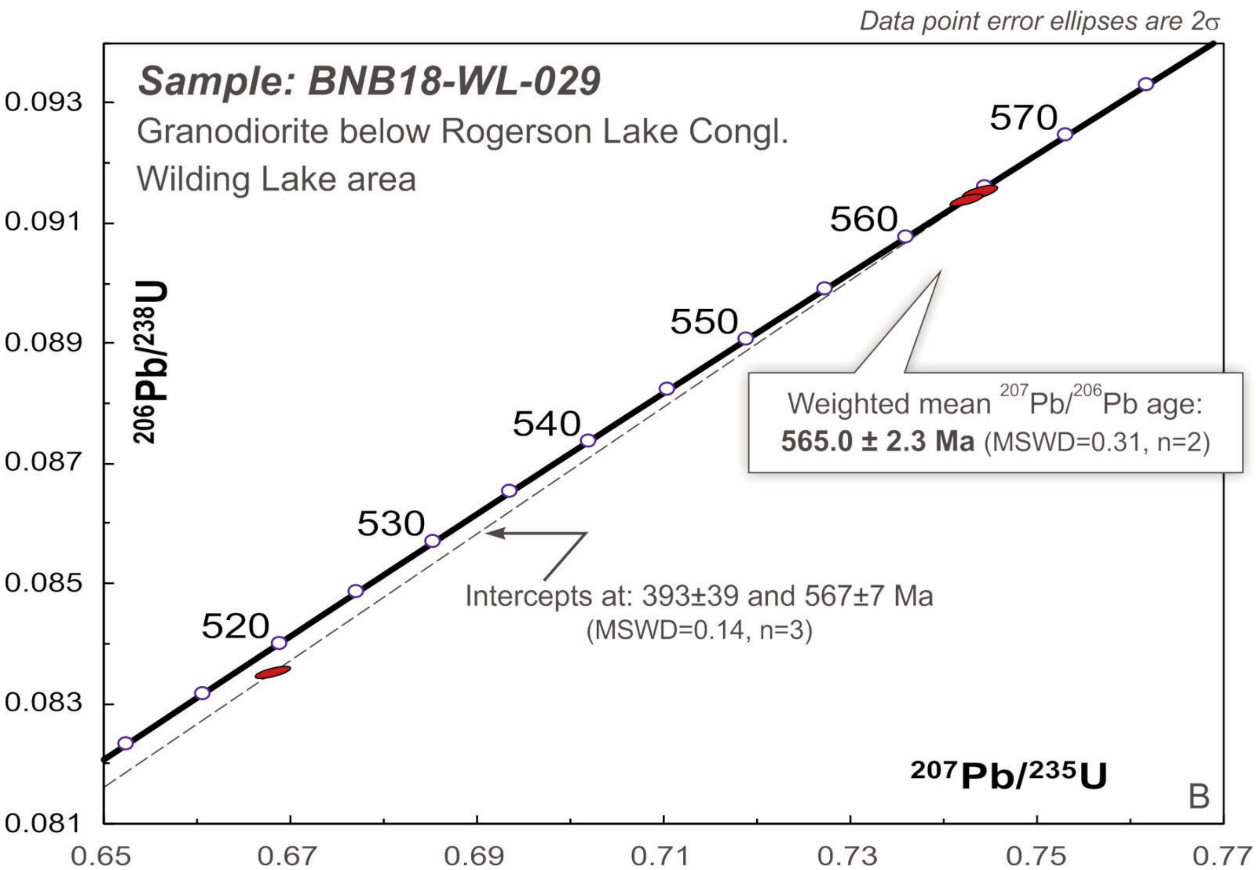

Figure 3B. *U–Pb Concordia diagram for granodiorite sample BNB18-WL-029.*

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REFERENCES

Bleeker, W.

2015: Synorogenic gold mineralization in granite-greenstone terranes: The deep connection between extension, major faults, synorogenic clastic basins, magmatism, thrust inversion, and long-term preservation. *In* Targeted Geoscience Initiative 4: Contributions to the Understanding of Precambrian Lode Gold Deposits and Implications for Exploration. *Edited by* B. Dubé and P. Mercier-Langevin. Geological Survey of Canada, Open File 7852, pages 25-47.

Colman-Sadd, S., Hayes, J. and Knight, I.

1990: The geology of the Island of Newfoundland. Map 90-01, Scale 1:1 000 000. Government of Newfoundland and Labrador, Department of Mines and Energy, Geological Survey Branch, GS# NFLD/2192.

Dunning, G.R., O'Brien, S.J., Colman-Sadd, S.P., Blackwood, R.F., Dickson, W.L., O'Neil, P.P. and Krogh, T.E.

1990: Silurian Orogeny in the Newfoundland Appalachians. The Journal of Geology, Volume 98, Number 6, pages 895-913.

Evans, D.T.W., Kean, B.F. and Dunning, G.R.

1990: Geological studies, Victoria Lake Group, central Newfoundland. *In* Current Research. Government of Newfoundland and Labrador, Department of Mines and Energy, Geological Survey Branch, Report 90-1, pages 135-144.

Honsberger, I. and Bleeker, W.

2018: Orogenic comparison of structurally controlled gold systems of the Abitibi greenstone belt and central Newfoundland Appalachians: Implications for Newfoundland gold potential and recurring tectonic drivers of gold mineralization. *In* Targeted Geoscience Initiative: 2017 Report of Activities, Volume 2. *Edited by* N. Rogers. Geological Survey of Canada, Open File 8373, pages 65-70.

Honsberger, I.W., Bleeker, W., Sandeman, H.A.I. and Evans, D.T.W,

2019a: Lithological and structural setting of structurally controlled gold mineralization in the Wilding Lake region, central Newfoundland. *In* Targeted Geoscience Initiative: 2018 Report of Activities. *Edited by* N. Rogers. Geological Survey of Canada, Open File 8549, pages 59-69, http://doi.org/10.4095/13640.

2019b: Structural geology of a gold-bearing quartz vein system, Wilding Lake region, central Newfoundland. *In* Current Research. Government of Newfoundland and Labrador, Department of Natural Resources, Geological Survey, Report 19-1, pages 23-28.

Jaffey, A.H., Flynn, K.F., Glendenim, L.E., Bentley, W.C. and Essling, A.M.
1971: Precision measurement of half-lives and specific activities of ^{235}U and ^{238}U. Physical Review, Volume C4, Issue 5, pages 1889-1906.

Ludwig, K.R.
2008: User's Manual for ISOPLOT 3.60 – A Geochronological Toolkit for Microsoft Excel. Berkeley Geochronological Centre Special Publication Number 4, 54 pages.

Lycopodium Minerals Canada Ltd.
2018: Preliminary economic assessment of the valentine lake gold project Newfoundland, NL, Canada; Marathon Gold. <www.marathon gold.com/site/assets/files/5047/2018-10-pea.pdf> [accessed December 2, 2018]

Mattinson, J.M.
2005: Zircon U–Pb chemical abrasion ("CA-TIMS") method: Combined annealing and multi-step partial dissolution analysis for improved precision and accuracy of zircon ages. Chemical Geology, Volume 220, Issues 1-2, pages 47-66.

McNicoll, V., Squires, G.C., Kerr, A. and Moore, P.J.
2008: Geological and metallogenic implications of U–Pb zircon geochronological data from the Tally Pond area, central Newfoundland. *In* Current Research. Government of Newfoundland and Labrador, Department of Natural Resources, Geological Survey, Report 08-1, pages 173-192.

Rogers, N., van Staal, C.R., McNicoll, V.J., Pollock, J., Zagorevski, A. and Whalen, J.
2006: Neoproterozoic and Cambrian arc magmatism along the eastern margin of the Victoria Lake Supergroup: A remnant of Ganderian basement in central Newfoundland? Precambrian Research, Volume 147, pages 320-341.

Valverde-Vaquero, P., van Staal, C.R., McNicoll, V. and Dunning, G.R.
2006: Mid–Late Ordovician magmatism and metamorphism along the Gander margin in central Newfoundland. Journal of the Geological Society of London, Volume 163, pages 347-362.

Williams, H.
1978: Tectonic lithofacies map of the Appalachian Orogen. Scale 1:1 000 000. Memorial University of Newfoundland, St John's, Newfoundland and Labrador.