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


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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 drillhole (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 $^{207}\text{Pb} / ^{206}\text{Pb}$ 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

<table>
<thead>
<tr>
<th>Analysis No.</th>
<th>Weight (μg)</th>
<th>U (ppm)</th>
<th>Th/U</th>
<th>Pbc (pg)</th>
<th>$^{206}$Pb/$^{238}$U</th>
<th>$^{207}$Pb/$^{235}$U</th>
<th>$^{208}$Pb/$^{235}$U</th>
<th>$^{206}$Pb/$^{238}$U</th>
<th>$^{207}$Pb/$^{235}$U</th>
<th>Error Corr.</th>
<th>$^{206}$Pb/ $^{238}$U</th>
<th>$^{207}$Pb/ $^{235}$U</th>
<th>$^{206}$Pb/ $^{238}$U</th>
<th>$^{207}$Pb/ $^{235}$U</th>
<th>Disc. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zr1</td>
<td>21.5</td>
<td>115</td>
<td>0.71</td>
<td>0.62</td>
<td>23327</td>
<td>0.74388</td>
<td>0.091500</td>
<td>0.000097</td>
<td>0.0058963</td>
<td>0.663</td>
<td>564.40</td>
<td>0.57</td>
<td>564.7</td>
<td>0.9</td>
<td>565.7</td>
</tr>
<tr>
<td>Zr2</td>
<td>16.2</td>
<td>121</td>
<td>0.88</td>
<td>0.67</td>
<td>17305</td>
<td>0.74249</td>
<td>0.091385</td>
<td>0.000091</td>
<td>0.0058928</td>
<td>0.705</td>
<td>563.72</td>
<td>0.53</td>
<td>563.9</td>
<td>0.8</td>
<td>564.4</td>
</tr>
<tr>
<td>Zr3</td>
<td>19.6</td>
<td>12</td>
<td>0.19</td>
<td>0.42</td>
<td>2893</td>
<td>0.66817</td>
<td>0.083518</td>
<td>0.000083</td>
<td>0.0058024</td>
<td>0.706</td>
<td>517.09</td>
<td>0.49</td>
<td>519.6</td>
<td>0.9</td>
<td>530.7</td>
</tr>
</tbody>
</table>

Notes:
- Single zircon grains (Zr) have been thermally annealed and etched in HF (Mattinson, 2005).
- Th/U calculated from radiogenic $^{206}$Pb/$^{238}$U 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 $^{208}$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.
Rogerson Lake Conglomerate
gabbro-tonalite-granodiorite
sheared contact
core collected for U-Pb zircon geochronology

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.
ACKNOWLEDGMENTS

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