The Lower Caledonia Beryl Pegmatite (NTS 11E/08), Guysborough County, Nova Scotia

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Introduction

A beryl-bearing pegmatite was discovered during a Mineral Inventory Project field check of the Lower Caledonia Au-Pb-Zn prospect (NTS 11E/08), Guysborough County, in July 1999. The prospect and pegmatite occur 5 km west of the small community of Lower Caledonia along the road following West River St. Marys toward Caledonia (Fig. 1). The pegmatite had been noted during previous exploration of the prospect, but the presence of beryl was not previously recognized.

Geological Setting

The West River St. Marys follows the West River St. Marys Fault, the southernmost suture of the east-west Cobequid-Chedabucto Fault System which subtends mainland Nova Scotia from Canso to Cape Chignecto. At Lower Caledonia this fault marks the southern boundary of the St. Marys Graben. The graben consists of Carboniferous clastic sedimentary rocks of the Horton Group, and is in contact with Cambro-Ordovician Meguma Group metasedimentary rocks which underlie much of the area to the south (Fig. 1). These rocks belong to the Goldenville Formation, the lower of two formations that constitute the Meguma Group. Intense ductile and brittle deformation related to movements along the fault have affected rocks on both sides of its trace.

In the Lower Caledonia area, the metasedimentary rocks form a scarp along the graben and consist of an interbedded sequence of metawacke, metasiltstone and minor slate. The scarp is intruded by numerous elongate plutons and dykes of foliated two-mica

![Map of the Lower Caledonia area, Guysborough County, showing the location of gold and base metal occurrences and the beryl-bearing pegmatite.](map.png)

*Figure 1. Geology of the Lower Caledonia area, Guysborough County, showing the location of gold and base metal occurrences and the beryl-bearing pegmatite.*
leucolonzogranite of Devono-Carboniferous age (Faribault, 1886, p. 142). One of these elongate granitic plutons is found at Lower Caledonia (Fig. 1). Geological mapping and diamond-drilling, part of the previous mineral exploration efforts at the Lower Caledonia prospect, have shown that the mineralized quartz veins intrude highly deformed and hydrothermally altered metasediments in the exo-contact zone of this pluton. Although the relationship between gold-bearing veins and granite is somewhat unclear, there is little doubt that the beryllium-bearing pegmatite is genetically related to granite.

**Exploration History**

**Gold Exploration**

The year of discovery of the gold-bearing quartz veins at Lower Caledonia is not known for certain, but the first report of exploration work dates to 1937 (Goudge, 1937). By that time a 5 m deep shaft had been sunk and considerable trenching had been done at one site (McLaren workings on Fig. 1), and substantial trenching was in progress at a second site high on the west bank of Rocky Brook (MacIntosh workings on Fig. 1). Several references (cited below) following these 1937 reports refer to the MacIntosh workings as including a short adit that over the years has collapsed. Whether or not there actually was an adit cannot be confirmed.

The targets of these early exploration efforts were several highly deformed, auriferous quartz veins that intrude schistose and highly altered Goldenville Formation metasediments. Goudge (1937) indicated that the north trench at the McLaren workings exposed a “10” roll of quartz” and several other east-trending quartz veins that total 10 cm in width. These veins reportedly returned assay results of $13.00/ton. Several other leads were exposed in the trenched and cleared area surrounding the shaft (Fig. 1). The MacIntosh workings consisted of an 18 m long trench that exposed a 17 cm thick vein trending east and shallowly dipping to the southeast. Later in 1937, a trench some 6 m long, 4.5 m wide and 4 m deep was dug in the west bank of Rocky Brook. It is possible that shortly after that time this trench was deepened and extended as an adit.

In a memo appended to the collection of miscellaneous memos that constitute the Goudge (1937) reference, the Provincial Mines Inspector R. I. Grant reported in 1946 that considerable bulldozer trenching had been done at the McLaren workings and several flat-lying quartz veins were exposed. In a similar visit in 1952, Mr. Grant reported that “free Au occurred in highly contorted quartz in schisted slate”. He also noted the presence of pyrite, chalcopyrite, pyrrhotite, sphalerite and galena in the veins. This is the first mention of base metal mineralization. McDonough (1953), working for Hemany Mines Limited, reported gold assays of 0.243, 0.91, 0.6, 0.28 and 0.243 oz./ton for chip samples collected over intervals of between 6 and 18 m from several of the trenches at both the McLaren and MacIntosh workings. In addition, a sample of 290 pounds was submitted to the federal government Mines Branch for treatment tests (see Appendix to McMullin, 1976). The tests returned a head grade of 0.26 oz. Au/ton and 0.37 oz./ton by screen analysis. Despite these encouraging results, Hemany did not continue exploration.

**Base Metal Exploration**

Interest in the base metal potential of the prospect did not commence until after release of the results of a stream sediment sampling survey carried out by the Geological Survey of Canada throughout northern Nova Scotia (Geological Survey of Canada, 1959). This survey showed a cluster of geochemical Pb anomalies in streams draining north from the Meguma Group basement into the West St. Marys River in the area between Caledonia and Glenelg. These results spurred Jonmar Syndicate to carry out follow-up soil geochemical, IP, resistivity and magnetometer surveys in the early 1960s (Meagher, 1966). Several areas of anomalous Pb and Zn were defined, as well as some geophysical targets. Trenching and one diamond-drill hole resulted in discovery of several base metal occurrences (Fig. 1). Trenching at two sites, one along what became known as Galena Brook about 1 km west of the gold prospect and another along the West River St. Marys near the mouth of Rocky Brook, exposed fault- and fracture-controlled Zn (0.3-1%), Pb (trace - 0.1%) and Ba (0.05-0.07%). At a third site, one diamond-drill hole was drilled to a depth of 60 ft. before being abandoned due to drilling problems and poor core recovery (15%). The hole was collared in an apparent fault or breccia zone and consisted mostly of broken metasediment to a depth of 59 ft., after which altered pegmatite was intersected for the remaining foot of the hole. Meagher (1966) reported that galena and carbonate coat the fracture surfaces on approximately half the metasediment fragments recovered, and traces of sphalerite and pyrite occur within the pegmatite.

Promising results from the Jonmar exploration and indications of base metal mineralization throughout this region found by the concurrent Nova Scotia Department of Mines St. Marys River Basin Project (including diamond-drill intersections of galena), led A. C. A.
Howe International Limited to acquire the ground and explore the Lower Caledonia prospect (Armstrong, 1969). This exploration effort was the first to note the presence of the large pegmatite dyke at Lower Caledonia. One of their three diamond-drill holes (DDH 69-1) was intended to test the relationship between the pegmatite and gold-bearing veins at the McLaren workings (Fig. 2). The drillhole proved the mixed pegmatite/granite dyke is still of substantial thickness between the easternmost of the pegmatite outcrops and the trenches of the McLaren workings (Fig. 2) but failed to shed much light on the relationship between the two. A second drillhole (DDH 69-2 on Fig. 2) was intended to test for pegmatite extension below and east of the shaft. This drillhole intersected mixed metawacke and schist and several quartz veins before passing into granite at 112 ft.* No gold was noted in the veins but "smears of steel galena" were common on fractures in the metasediment. The third drillhole at the MacIntosh workings quickly intersected granite and was abandoned. Armstrong (1969) concluded from the drilling that the entire area is underlain at shallow depth by granite and that this severely limits the tonnage potential of any mineral occurrence found in the metasediments. As a result the ground was dropped. He did not consider that base metals may be hosted by the granite.

The Armstrong (1969) report includes a map showing an area of "Au in drift" extending from the pegmatite dyke and McLaren workings and continuing farther to the east almost to Rocky Brook. The map also indicates the notation "Au-Te found in place" along the west bank of Rocky Brook, roughly corresponding with the MacIntosh workings. As interesting as these notations are, there is no further mention of them provided in the report.

McMullin (1976) carried out exploration of the site on behalf of Great Horn Mining Syndicate Inc. between 1972 and 1976. This effort focused on the gold and base metal potential of the site due to the increasing value of gold in the mid-1970s. Further geochemical surveys and a re-analysis of previous geophysical data indicated several strong exploration targets. One of these was tested with diamond-drill hole DDH 3-1 (Fig. 2) which was collared along the access road immediately southwest of the westernmost pegmatite outcrop and was drilled due south inclined at 45°. The drill log (McMullin, 1976) indicates that the hole intersected metasediment to a depth of 114 ft then passed into mixed intervals of pegmatite, granite and metasediment to the end of the hole at 341 ft. No mineralization of any sort is indicated in the drill log, although it shows that at least one other pegmatite dyke of significant dimension occurs on the property.

In 1977 a second diamond-drill hole was drilled north from a site located approximately 100 m south of the McLaren workings to test an IP geophysical anomaly centered in that area (DDH 3-2 on Fig. 2; McMullin, unpublished data). The drillhole intersected highly contorted, garnetiferous schist and metawacke to a depth of 100.6 m below which a mixed sequence of schist, pegmatite and leucogranite were encountered to the bottom of the hole at 106.4 m. Minor to trace amounts of fracture-controlled galena and sphalerite occurred in the schist throughout the hole. The highest assay result was 0.15% Pb and 0.33% Zn. There is no mention of mineralized zones in the pegmatite and leucogranite.

**Description of the Pegmatite**

The beryl-bearing pegmatite dyke strikes 114° and has a strike length of at least 125 m as defined by the three outcrops and DDH 69-1 (Fig. 2). The width varies from 14-20 m at its east end to 2 m at its west end. The western outcrop is small and entirely pegmatite, so the possibility remains that the dyke is actually wider in that area but covered by till. In any event, it does appear as if the dyke narrows toward the west.

**The East Outcrop**

The easternmost pegmatite outcrop has a rounded, typically glaciated form, approximately 20 m long by 8-10 m wide (Fig. 3). The outcrop is predominantly pegmatitic, but does include gradational patches of leucogranite, especially along its northern margin and west-central portion of the outcrop. In addition, there are several enclaves of highly deformed schist incorporated within the dyke. The deformation is irregular, with patches exhibiting a well developed planar fabric, indicating intense localized ductile deformation, intermixed with what appears to be massive, undeformed pegmatite. However, on close examination, the widespread presence of minute layering within individual clear quartz crystals in the pegmatite is an indication of deformation on a microscopic scale. In all likelihood, each layer represents a separate micro-shear plane. A similar phenomenon is displayed within highly sheared quartz at the Jordan Falls Be pegmatite (Mineral Occurrence #P14-001) north of Shelburne in southwest Nova Scotia (Corey, 1994).

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* Cores that were logged in feet are cited in feet and not converted to SI units.
Figure 2. Geology map of the Lower Caledonia beryl pegmatite and McLaren workings of the Lower Caledonia Au-Pb-Zn prospect. Inset is a cross-section along diamond-drill hole 69-1 of Armstrong (1969).

The pegmatite is irregularly zoned. In general, there is a margin of coarse-grained quartz-K-feldspar-muscovite pegmatite which, in places, resembles a very megacrystic, highly evolved granite. The center or core portion of the outcrop is more K-feldspar-rich and consists predominantly of a mix of quartz and K-feldspar or, in some areas, essentially totally K-feldspar. Tourmaline occurs as fine- to medium-grained, euhedral, black crystals predominantly concentrated in the marginal zone of the pegmatite. Tourmaline is
especially concentrated adjacent to the schistose country rock or surrounding schist enclaves. There are a couple of patches of massive, fine-grained tourmaline and the black mineral imparts a dark colour such that these patches are easily mistaken for schist. Armstrong (1969) reported that garnet occurs in the pegmatite intersections in his diamond-drill holes, but garnet was not noted in any of the outcrops during the current study.

The east outcrop contains the highest concentration of beryl. A large portion of the central to southwest end of the outcrop reaches a very impressive 30-40 modal % of the mineral and is likely the richest Be occurrence known in the province. The beryl occurs as coarse euhedral to subhedral crystals (Fig. 4), generally with a cream to yellowish-cream colour. Several crystals are in the order of 4-6 cm in diameter. Beryl also occurs with tourmaline in two flat-lying to shallow-dipping quartz veins that intrude the pegmatite along the southeast end of the outcrop. The veins are between a few centimeters to 25 cm thick and the beryl occurs predominantly along the vein margin, although a few also occur within the veins themselves.

Armstrong (1969) drilled a hole (DDH 69-1 in Fig. 2) to examine the relationship of the pegmatite with the gold- and base metal-bearing quartz veins at the McLaren workings. The inset in Figure 2 shows this drill section and it is clear from it that the mixed pegmatite/leucogranite dyke underlies essentially all of that area. Armstrong makes no note of beryl occurring in either the drill core or in the pegmatite outcrops. Unfortunately, the drill core has long since been dumped.

The Middle Outcrop

The middle outcrop, largest of the three pegmatite exposures, takes the form of a rounded roche moutonée approximately 35-40 m long and 8-12 m wide. Much of the outcrop is well developed pegmatite, although, like the east outcrop, gradational leucogranite lenses occur. Schist enclaves are also present. The outcrop is irregularly zoned with a border facies of quartz - K-feldspar ± muscovite pegmatite grading into a central core of very coarse-grained K-feldspar ± quartz.
pegmatite. The northern margin of the outcrop has a pronounced steep face dropping some 5 m down into a swampy area. The face is moss covered, but pegmatite was found underneath in several locations examined in the field check. It is not known how far under the swamp the pegmatite dyke extends toward the north.

A few beryl crystals were noted in the middle outcrop but there were no rich concentrations as exposed in the east outcrop. Euhedral, black tourmaline crystals also occur sporadically as do rare patches of massive, fine-grained tourmaline.

**The West Outcrop**

The westernmost outcrop is the smallest of the three at about 10 m long, 1-2 m wide and 1 m high. The southern margin of the outcrop appears to be in contact with schist country rock but the north contact is obscured due to till cover along the northern margin, so the true width of the pegmatite is uncertain. Most of the outcrop consists of an assemblage of K-feldspar - quartz - muscovite with lenses of leucogranite intermixed. The outcrop displays evidence of ductile deformation, particularly in the lenses of leucogranite which display a well developed planar fabric. Although the leucogranite appears to be more deformed than the pegmatite, it is important to note that in this outcrop the planar fabric continues outward from the leucogranite and into the pegmatite along discrete shear zones.

A few beryl crystals were noted in the central portion of the outcrop near its eastern end. In addition, a few fragmented and boudinaged beryl crystals were noted within a well foliated section along the north edge of the outcrop about half way along its length.

**Other Pegmatites**

A few other occurrences of pegmatite were noted in the exploration assessment files for Lower Caledonia. McMullin (1976) drilled a diamond-drill hole along the woods road immediately south and a few metres west of the westernmost pegmatite outcrop (Fig. 2). Core from this hole has since been dumped, but the log provided by McMullin (1976) indicates it intersected a 60 m thick mixed sequence of highly deformed schist, pegmatite and granite. This hole was collared to the south of the
exposed pegmatite dyke and was drilled toward the south (i.e. away from the outcropping dyke). This indicates that a second, possibly en echelon, pegmatite dyke (or more than one) underlies the area south of the exposed pegmatite. Whether this second dyke is beryl-bearing is not known.

Meagher (1966) reported pegmatite dykes in three separate areas during the Jonmar Syndicate exploration of the site. Along the south bank of the West River St. Marys, immediately east of the mouth of Rocky Brook, an exploration trench exposed a major east-trending fault zone in which the gouge/breccia is intruded by a small pegmatite dyke. Galena, sphalerite and pyrite smears on the fracture surfaces of breccia fragments are common and the gouge returned assays of 1% Zn and anomalous levels of Pb and Ba. There is no indication if the pegmatite was mineralized. A diamond-drill hole (C-1-59; Meagher, 1966), put down to test a soil geochemical anomaly located a few hundred metres northwest of the McLaren workings, collared in a breccia zone from which there was only 15% core recovery. Most of the material recovered consisted of fragments of metawacke with common smears of galena. However, the bottom foot of the drillhole encountered pegmatite before the hole was lost due to a broken casing. The pegmatite is described as being “intergrown quartz and white felspar with minor white mica” (Meagher, 1966). Sphalerite and pyrite are reported in the pegmatite. It is also interesting that the compilation map in Meagher (1966) indicates an outcrop of pegmatite about 10 m south of DDH C-1-59 and at the contact of metasediment with the granite pluton. Conceivably, the pegmatite encountered in the drillhole and this pegmatite outcrop may represent a single intrusion.

Meagher (1966) indicates an outcrop of pegmatite roughly 365 m west, and along strike of the beryl-bearing pegmatite at the McLaren workings. This outcrop is not discussed in his assessment file so it is not known if it is a firm indication of an extension of the beryl-bearing pegmatite or merely a minor dyke or vein.

**Discussion**

The presence of abundant beryl in the pegmatite at Lower Caledonia has significant exploration implications that warrant further attention. First, since the presence of high-grade beryl was not previously known, the extent of the Be enrichment in the pegmatite needs evaluation and the exact dimensions of the dyke need to be better defined. It is widely known that pegmatites tend to occur in swarms or groups of dykes. This observation holds true at Lower Caledonia where there is strong evidence that there is more than one pegmatite dyke present. In addition, pegmatites that host high concentrations of Be often host other economically important rare metals (e.g. Cs, Rb, Ta, Nb, Sn). Further exploration of the Lower Caledonia pegmatite(s) should address the potential for these other commodities.

Exploration at Lower Caledonia began with an interest in finding gold deposits then shifted to the potential for base metals. The relationship between beryl (inc. other rare metals?) mineralization, base metal mineralization and gold-bearing veins is, at present, poorly understood. Clearly, this relationship needs further evaluation. One common denominator is the spatial association of all three mineralization styles with the elongate leucogranite intrusions. This association goes farther to the Lower Caledonia area, as several other elongate, dyke-like intrusions of leucomonzoanogranite and leucogranite intrude the Meguma Group metasediments along tens of kilometres of the east-trending Cobequid-Chedabucto Fault Zone from Melrose to Trafalgar. Faribault (1886) provides a description of the granite plutons along this section and makes particular note of their elongate, dyke-like form. Plutons of several kilometres length are typically no more than a few hundred metres wide indicating a length to width ratio greater than 20:1. The plutons are deformed, but sporadically so and not to a degree consistent with the observed length to width ratios. Tectonic stretching of what was originally an undeformed pluton of roughly random or ameboid shape, to the degree consistent with these ratios would result in complete recrystallization or mylonitization. This is not the case. The plutons display a planar fabric but much of the original magmatic texture remains. Typically, the central portion of the plutons exhibit only a weakly developed fabric. From this it is fair to conclude that their elongate form is, at least in part, a primary or syn-intrusion feature indicating the melts were emplaced into an actively shearing environment.

The numerous base metal occurrences and geochemical anomalies along this section of the fault zone and their association, at least spatially, with the elongate plutons is interesting to say the least. The realization that the granite magmas that gave rise to the plutons were evolving a fluid phase and producing a significant volume of pegmatite, and that these pegmatites are rich in rare metals, only furthers the economic potential of the area.
References


Goudge, M. G. 1937: Miscellaneous memos regarding exploration at Lower Caledonia; Nova Scotia Department of Natural Resources, Assessment Report 11E/08B 21-G-28(00). 


