EMERALD AND OTHER GEM BERYL MINERALIZATION IN NORTHWESTERN CANADA

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INTRODUCTION

Emerald is green gem beryl (Be$_3$Al$_2$Si$_6$O$_{18}$), in which colour is related to minor amounts of contained Chromium (Cr) or Vanadium (V). Emerald is the third most valuable gemstone (after diamond and ruby) and can be worth more than US$100,000 per carat. Other gem varieties of beryl include aquamarine (blue), bixbite (red), goshenite (colourless), heliodor (yellow), morganite (pink), and rosterite (pink). Canada is not currently a producer of coloured gemstones, but this could change as a result of several exciting new discoveries in northwestern Canada. These, in turn, have prompted exploration expenditures of approximately $3 500 000 in 2003 in the Yukon Territory alone.

LENED

In 1997, an occurrence of V-dominant emerald was discovered near the mid-Cretaceous Lened pluton in the southwestern Northwest Territories. Pale to medium green emerald crystals up to 3 centimetres in length occur where quartz veins cut a garnet-diopside skarn developed from a limestone of the Rabbitkettle Formation that overlies V-rich (2070-3170 ppm) black shales of the Earn Group. The proximity of the granite suggests that it is the source of the Be, although the Be content is low (6 to 7.3 ppm), but the source of the V is undoubtedly the shale. A fluid inclusion study (Marshall et al., 2004) suggests that the emerald crystals formed at temperatures of 250 to 550°C and pressures of less than 3700 bars. Questions remain about the relative timing of the skarn formation, vein emplacement, and thrust faulting.

REGAL RIDGE

In 1998 a major occurrence of emerald was discovered at Regal Ridge in the southeastern Yukon Territory in northwestern Canada. The mineralogy, geology, and origin of the occurrence are described in Groat et al. (2002). The mineralization is associated with quartz veins and aplite dikes that intrude metavolcanic rocks of the Yukon-Tanana Terrane. Green beryl crystals up to 4 centimetres in length are found in 12 mineralized zones within a 900 by 450 metres area. Cr averages 3208 ppm and is the predominant chromophore. Some of the smaller crystals, and sections of larger crystals, are gem-quality, and a number of small gems (up to about 2.4 carat) have been fashioned from the Regal Ridge samples.

The Yukon-Tanana Terrane in the Regal Ridge area is composed of mainly Devonian quartz-rich metaclastic rocks and carbonates, and Devonian and Mississippian metavolcanic and metaplutonic rocks that are inferred to have formed in continental magmatic arc (Mortensen and Jilson, 1985; Mortensen, 1992; Murphy and Piercey, 2000) and back-arc settings (Piercey et al., 2000). The oldest rocks are in the Devonian to Mississippian Grass Lakes succession. The Fire Lake unit, a mafic metavolcanic unit composed mainly of chloritic phyllite (Murphy et al., 2002), is the second-oldest unit within the succession. These rocks were thrust onto the North American miogeoclone between late Triassic and earliest Cretaceous time. The Yukon-Tanana rocks are intruded by several ca. 112 Ma intrusions of the Cassiar-Anvil plutonic suite. The Tintina fault lies 14 kilometres southwest of the property.

The main host rock for the mineralization is a chlorite-plagioclase schist that is part of the Fire Lake unit (DF unit of Murphy et al., 2002). Geochemical analyses show that the schist is a high-Ca boninite. The Cr in the emerald most likely came from the schist (average 960 ppm Cr). A leuco-gabbro unit (Dmi unit) is closely interfingered with the mafic schist. Varially-serpentinized ultramafic rocks occur in the western and northern parts of the map area. Murphy et al. (2002) suggest that these represent intrusive sills that fed the overlying DF rocks via gabbroic dikes (Dmi).

The occurrence is underlain at a depth of approximately 800 metres by a 112 Ma two-mica (biotite > muscovite) quartz monzonite, which outcrops to the east, south, and north. The intrusion, which is weakly foliated to unfoliated with shallowly dipping contacts, belongs to the Anvil plutonic suite (Mortensen et al.,
Quartz veins are abundant throughout the property, and the majority appears to be related to Cretaceous deformation. Early veins are typically thin, foliation-parallel, sulphide-rich, and tourmaline free. All the other quartz veins, including those that contain beryl and emerald, contain at least some tourmaline, either within the veins or in the vein selvages. The degree of alteration surrounding the veins varies from none to metre-wide rusty-weathering zones in the schist. This rustiness is likely due to weathering of finely disseminated sulphides (especially pyrrhotite) that are common in the alteration zones adjacent to the veins.

Emerald is associated with veins with several orientations. Mineralization appears to be particularly well developed where veins of the youngest generation intersect older, more deformed veins. Emeralds occur along the margins of quartz veins in highly-altered schist, as well as within the quartz veins themselves. The mineralizing event is interpreted to have occurred over a considerable period of time, but was mainly syn- to late-tectonic, and coincided with the waning stages of quartz monzonite intrusion. Late ductile deformation has also affected some of the emerald-bearing veins, as evidenced by the presence of healed fractures in emerald and micro-boudinage of tourmaline grains within vein quartz. At least two of the aplite dikes contain beryl or emerald, which confirms our hypothesis that there is a continuum from the quartz monzonite intrusion through aplite dikes to beryl-bearing quartz veins (Neufeld et al., 2003).

OTHER BE AND BERYL OCCURRENCES IN NORTHWESTERN CANADA

A literature review of assessment reports and other published and unpublished reports shows numerous Be and beryl occurrences in southern Yukon and northern British Columbia. Analyses of a scapolite skarn with scheelite at the Myda claim (Yukon MINFILE 105G/071; www.geology.gov.yk.ca/minfile/, Deklerk, 2003), approximately 20 kilometres south of Regal Ridge, show 0.05 to 0.09 wt.% BeO, thought to be present in vesuvianite. Beryl has been reported from the Logtung W-Mo deposit (105B/039), the JC (Viola) Sn-bearing skarn claims (105B/040), and the Ice Lakes area (Groat et al., 1995). All are just north of the British Columbian Yukon border. Beryl has also been reported from the following showings and prospects in northern British Columbia (listed west to east): Jennings River 104O/028, Ash Mountain (104O/021), Blue Light (104O/005), Gazoo (104O/045), Low Grade (104P/026), Haskins Mountain (104P/020), and Cassiar Beryl (Horseranch Range, also called Wilson (Simandl et al. 2000) (104P/024). The numbers are British Columbia MINFILE property reference numbers. For on-line information, see http://www.em.gov.bc.ca/mining/Geolsurv/minfile/.

Most of these prospects are associated with Cretaceous plutons, in particular the Cassiar batholith. The occurrences listed here (including Regal Ridge) define a Be-rich area approximately 265 (northwest-southeast) by 125 kilometres (northeast-southwest) that straddles the
British Columbia-Yukon border and the Tintina Fault. Legun (2004) used data from assessment and other published reports to define a “beryl belt” extending from southeastern to northwestern British Columbia. Within the “beryl belt” he proposed a “principal area of emerald potential” which approximately coincides with this area.

Beryl has also been found at the Pluto property in the offset part of the Yukon-Tanana Terrane southwest of the Tintina Fault, close to Dawson City (116B/134). Other Be/beryl occurrences in northern British Columbia and the Yukon, and western Northwest Territories include Mount Foster (104/M14?), Kalzas (105M/066), Emerald Lake (115O/009), and the Little Nahanni Pegmatite Group (NORMIN.DB 105ISE0015, 25, 50-56; see www.nwtgeoscience.ca). At Mount Foster colourless to light blue aquamarine occurs in miarolitic cavities in granitic rocks (Wilson, 1997). Wilson has cut several stones from this locality; the largest are 8.63 and 2.99 carats, and although the 8.63 carat stone has many inclusions, stones that weigh less than two carats are virtually flawless (Wilson, 1997).

The discovery of emeralds at Regal Ridge and Lened, and gem beryl at True Blue, along with numerous reports of anomalous levels of Be and/or the presence of beryl in northwestern Canada, suggest the potential for more emerald and gem beryl occurrences in the Yukon, western Northwest Territories, and northern British Columbia. This area could represent one or more distinct beryl/emerald camp(s), as has been recognized at other places in the world.

SELECTED REFERENCES


