The relationship between mafic intrusive units and the Devil Pike Brook orogenic lode gold deposit, south-central New Brunswick

Jonathan Lafontaine[1], David R. Lentz[1], and Kathleen G. Thorne[2]
1. University of New Brunswick, Department of Geology, PO Box 4400, Fredericton, NB, E3B 5A3 <jonathan.lafontaine@unb.ca> ¶ 2. New Brunswick Department of Natural Resources, Geological Surveys Branch, PO Box 6000, Fredericton, NB, E3B 5H1

The Devil Pike Brook gold-bearing quartz-carbonate vein system is located in a deformed band of mafic volcanic rocks of the Grant Brook Formation (Mascarene Group) in south-central New Brunswick. The locally high grade (>200 ppm), structurally controled veins are generally north-trending, consistent with the localized intense foliation, but oblique to the regional NE structural trend. The occurrence is located approximately 500 m south of the regional northeast-trending Taylor Brook Fault Zone that separates the Early Silurian Mascarene Group to the south and the Late Cambrian to Early Ordovician Annidale Group to the north. It is believed that this major terrane boundary, probably related to back-arc basin closure and reactivated during later tectonic events, is a strong controling factor in the formation of the deposit, which is typical of structurally controled orogenic deposits. Also consistent with other structurally-controled lode gold deposits, mafic intrusive units and notably an alkali feldspar-phyric gabbro are present in the vicinity of this gold deposit and throughout the Mascarene Belt. These units are unrelated to the vein-hosting mafic volcanic rocks and, although it is unlikely that they

represent a precious metal source, they are responsible for generating a thermal anomaly possibly concurrent with gold deposit formation.

Geochemical analyses (XRF, INAA, and ICP-MS) appear to support a singular mantle-derived within-plate tholeiitic basaltic magmatic source for all intrusive units in the Mascarene Belt, though individual units were tapped at various evolutionary stages. Also, the crystallization sequence appears to have been completed without mineral segregation during cooling: there does not appear to be any plagioclase fractionation, suggesting lower to mid-crustal emplacement levels. These two aspects suggest that the intruding system resembles a large, deep-seated parent with lower to upper crustal dyke emplacement. The importance of these intrusive units lies in that they may have played a role in heat advection that may have been significant in the formation of the gold deposit, irregardless of the source of hydrothermal fluids. If gold-bearing hydrothermal fluids were generated by metamorphic devolatilization reactions, deep mafic intrusions (similar to the nearby Stewarton Complex) may have played an important part in accelerating dehydration-decarbonation reactions. Conversely, if gold-bearing hydrothermal fluids were derived from infiltrated meteoric water, high-level bodies may have aided the circulation by creating more prominent buoyancy contrasts through fluid temperature increase. These two non-exclusive fluid source end-members may contribute to a mixed hydrothermal fluid source from which lode gold deposits may form.

Thermal modeling using HEAT 3D (Kware, programmed by K. Wohletz) has shown that duration of thermal influence on surrounding lithologies is approximately 1–2 Ma for high level intrusive units, possibly as much as 3–4 Ma for larger deep intrusions. Although the aforementioned effects occur unequivocally, it is difficult to appropriately assume that thermal anomalies can be specifically related to a deposit due to radiometric dating technique constraints. Synchronous lode gold deposit formation and mafic intrusion emplacement within the 4 Ma period of the thermal anomaly may be sufficient to suspect the causality of heat advection in the formation of a lode gold deposit.