Petrological Studies of Mafic Pegmatites in the Jurassic North Mountain Basalt, Nova Scotia: A Record of Extreme Fractionation in the Late-stage Evolution of Continental Tholeiites[1]

C. Baldwin[2], D. J. Kontak and J. Dostal[2]

The 201 Ma North Mountain Basalt (NMB) is a sequence of continental tholeiitic basalts erupted within a continental rift (Fundy Basin) that has been subdivided into lower, middle and upper flow units (LFU, MFU, UFU, respectively). Petrographically the basalts are medium- to fine-grained with ophitic textures and are variably vitrophyric (≤30%). The LFU is ≤190 m thick and massive in nature with well-developed colonnade and entablature fracture patterns. However, two exceptions are noted, namely the presence of a thin (≤1-3 m) amygdaloidal zone delineating the upper contact with the overlying MFU and rare, locally-developed pegmatite sheets in the upper part of the flow. This study focuses on two pegmatite localities, namely Mount Pleasant and Beamans Mountain, that outcrop near Digby. These areas were previously exploited for aggregate, the resultant excavations having provided exceptional exposure of the pegmatites sheets. The two areas were examined in detailed and mapped onto digitally-generated photos with subsequent sampling for petrography, and mineral and whole-rock geochemistry. We note the following textural and mineralogical features of the pegmatites, which are appropriately named given the presence of abundant, coarse (i.e., ≤10-15 cm) pyroxene crystals: (1) the contacts are welded with the host basalt and chilling is apparent; (2) the sheets are ≤3 m thick, but cm-scale lenses occur, and bifurcation is common; (3) internal zonation occurs, as defined by textural variation and different proportions of pyroxene, plagioclase and an aphanitic beige matrix; locally, pyroxenite occurs; (4) skeletal pyroxene is a prominent feature, often with comb and radial textures; (5) thin (≤1-2 cm), flat veins/dykes of aphanitic, beige felsite (i.e., granophyre in thin section) cut the pegmatites and locally they are miarolitic and globules of red-brown (rhyolitic ?) glass; (6) the pegmatites are dominated by coarse, normally zoned pyroxene that show prominent Fe enrichment with Fe/(Fe+Mg) to 0.8 and plagioclase (An_{40-70}) that may contain 0.5-1% wt.% FeO. Late phosphorus enrichment is manifested by abundant apatite euhedral in the granophyre and felsic glass.

Our observations indicate the pegmatites represent filling of flat to undulating dilatant zones within crystallized basalt by a mobilized, possibly filter-pressed, evolved melt generated via fractionation from a precursor basaltic magma. The heterogeneity nature of the pegmatite, locally Fe-rich pyroxenite, and presence of globules of rhyolite suggest that liquid immiscibility, documented elsewhere in the NMB, in addition to fractional crystallization, may have occurred within the basaltic magma.

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[2]Department of Geology, St. Mary's University, Halifax, Nova Scotia B3H 3C3