Documentation of abundant intergranular felsic mesostasis in the Jurassic North Mountain Basalt, Annapolis Valley, Nova Scotia: product of silicate liquid immiscibility

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The presence of liquid immiscibility has been recognized as an important phenomenon in igneous petrology from several decades of field and laboratory studies; however, the extent of this process remains poorly understood. In some cases there are obvious field relationships that suggest immiscibility, whereas in other cases the evidence is relatively ambiguous - the Jurassic (ca. 200 Ma) North Mountain basalts of southern Nova Scotia represent such a case. Previous work indicates that rare occurrences of thin, felsic bands within thick basalt sequences are products of silicate liquid immiscibility rather than crystal fractionation. Here we report the occurrence of pervasive development of silicate liquid immiscibility based on detailed imaging and electron microprobe analysis of fresh, in part glassy, phyric to aphyric basalts from several localities of the North Mountain Basalt. The fine- to medium-grained basalts consist of variable amounts (≤20%) of phenocrystic plagioclase (An_{50-70}), augitic pyroxene ($En_{40-50}Wo_{30-40}Fs_{15-40}$) and Fe-Ti oxide phases within a fine-grained matrix of plagioclase microlites, equant clinopyroxene, and skeletal to equant Fe-Ti oxide phases. In plane-polarized light, a dark brown to black material (glass) forms a mesostasis in many of the samples, at times up 25-30 volume %. Imaging of the glassy phase indicates variable degrees of crystallization (feldspars, quartz, Fe-Ti oxide phases, Fe-rich pyroxene) and complex textures (granophyric, symplectic), but in some cases remnant globules are preserved. Analysis of the globules indicates two contrasting compositions, one enriched in Si, Al and alkalis and the other relatively enriched in Fe, Ti, and P. Where clinopyroxene is in contact with the matrix glass, an Fe-rich overgrowth (to $En_{10}Wo_{40}Fs_{50}$) is present. This Fe-enrichment is similar compositionally to pyroxene in mafic pegmatite at McKay Head, where immiscibility has been demonstrated in the basalts, and also coincides with the extreme Fe-rich trend in Skaergaard pyroxenes. Based on petrographic observations, imaging and microprobe analysis it is apparent that silicate liquid immiscibility was a significant process in the crystallization history of the North Mountain Basalt.