Petrographic and chemical characteristics of mafic dykes and sills in the Antigonish Highlands, Nova Scotia, Canada

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The Antigonish Highlands of northern mainland Nova Scotia have a long and complex tectonic history involving at least three major episodes of magmatism during the Late Neoproterozoic, Ordovician, and Devonian-Carboniferous. Mafic dykes and sills are abundant throughout the Antigonish Highlands, presumably related to one or more of these magmatic episodes. Dykes/sills have been observed at almost 200 locations, most in units older than the Silurian Arisaig Group. In Neoproterozoic stratified units, many of the sills were originally thought to have been flows. Wide variations in petrographic, magnetic, and chemical characteristics suggest multiple episodes of dyke/sill emplacement. Based on the petrography of 67 samples, two main types of sills and dykes are recognized: clinopyroxenebearing and plagioclase porphyritic. The clinopyroxenebearing group is subdivided into intergranular, coarsegrained, and secondary amphibole-bearing. Whole-rock chemical analysis of 33 of these dykes/sills shows that the majority are mafic (<52% SiO_2) but a few are intermediate with up to 55% SiO_2 . Loss on ignition is typically high (ca. 5–10%) consistent with extensive alteration in the rocks, including saussuritization of plagioclase and replacement of pyroxene by chlorite. Both major and trace elements show wide variation, likely also linked at least in part to alteration, and correlations between chemical characteristics and petrographic characteristics are not apparent in the existing data set, even when augmented by chemical data obtained using a portable XRF instrument. However, the dykes/ sills appear to fall into two distinct chemical groups based on tectonic setting discrimination diagrams using mainly immobile elements: volcanic-arc and within-plate. Samples in the volcanic-arc group are subalkalic and show chemical characteristics similar to those of the Neoproterozoic volcanic and plutonic units of the Antigonish Highlands, generally interpreted to have formed in a subduction zone. The within-plate samples are subalkalic transitional to alkalic and show chemical similarities to the Ordovician within-plate Ordovician plutonic and volcanic units of the Antigonish Highlands. However, a number of subalkalic samples are ambiguous in their classification and/or plot in units too young for them to be Neoproterozoic. None of the samples examined in thin section seem unaltered enough or have petrographic features to suggest that they are related to the Devonian-Carboniferous magmatic events.

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