The geology of mafic porphyry in the South Mountain Batholith, Nova Scotia

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The South Mountain Batholith (SMB) of southwestern Nova Scotia is a large (~7300 km^2) composite, peraluminous batholith mostly ranging in composition from biotite granodiorite to muscovite-topaz leucogranite. Geological mapping has outlined numerous small bodies (mostly <100 m^2 to 1 km^2) of fine- to coarse-grained, porphyritic rocks with high modal content of biotite and common metasedimentary xenoliths throughout the batholith. These rocks, termed mafic porphyry (MP), are minor volumetrically (~0.07%) but may provide insight into the early petrogenesis of the SMB. MP is mostly granodiorite to monzogranite in composition, with minor tonalite, and contains characteristic medium- to coarse-grained phenocrysts consisting of varying proportions of quartz, plagioclase, and alkali feldspar.

Several MP bodies lie at the margins of the batholith and have sharp intrusive contacts with adjoining granite phases and with the Meguma Supergroup (MSG). Other MP units are situated away from country rock contacts and typically have sharp intrusive contacts with other granitoid phases. These contacts are sinuous, ragged or lobate suggesting mingling of two magmas or crystal mushes of dissimilar composition. Numerous MP autoliths were noted throughout the batholith, mostly in granodiorite, but also in biotite and biotite-muscovite monzogranite units. MP autoliths typically contain abundant MSG xenoliths, even when observed in central regions of the batholith.

Modal concentrations of biotite vary widely in MP from 10–32%, although some bodies have a more restricted modal range (e.g. 15–20% in the Cloud Lake MP). Several MP bodies contain trace-2% reddish (almandine?) garnet. Muscovite is present only in trace amounts. The Boot Lake mafic porphyry contains trace (2%) andalusite. Several bodies and individual xenoliths have up to several modal percent sulphide minerals, including pyrite, pyrrhotite, and chalcopyrite.

Lithogeochemical analysis of MP rocks reveals a wide range in both major and trace element composition. A suite of samples from a large MP and granodiorite body in the north-central part of the SMB near Lake George underscores the compositional range in these rocks. Samples include biotite-rich MP with varying modal amounts of garnet and andalusite. The sequence is marked by large ranges in major element concentrations including 60.85–65.96% SiO_2; 4.89–7.64% Fe_2O_3; 1.12–3.21% CaO; 0.96–3.07% MgO; 0.68–1.06% TiO_2. Samples with the highest SiO_2 and the lowest Fe_2O_3, CaO, MgO, and TiO_2 closely resemble average biotite granodiorite of the entire batholith, whereas other samples have the lowest SiO_2 and highest concentrations of ferromagnesian and some 'compatible' elements (1101 ppm Ba; 209 ppm Sr; 338 ppm Zr; 27 ppm Sc; 65 ppm La) in the entire SMB.

MP rocks are interpreted as representing the first granitoids to crystallize in the SMB. The abundance of Meguma Supergroup xenoliths, coupled with the common occurrence of garnet, andalusite, and sulphide minerals, which are interpreted as xenocrystic or paraxenocrystic in origin, suggest that the MP is highly contaminated with MSG material. High concentrations of mafic minerals would result in higher specific gravity relative to other SMB rocks, resulting in 'sinking' of MP xenoliths as these rocks were subsequently intruded by more evolved granite phases.

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