U-Th-Pb systematics of the South Mountain Batholith, Nova Scotia

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Elemental concentrations of U, Th, Pb and Pb isotopic compositions for 34 samples were determined to assess the age, mobility of elements and source rock reservoirs for the peraluminous granitoids of the South Mountain Batholith. The concentrations (ppm) of U, Th and Pb range from 1.510-28.780, 1.483-18.403 and 2.25-24.87, respectively, and the measured $^{206,207,208}Pb/^{204}Pb$ isotopic ratios range from 18.627-51.945, 15.621-17.422 and 38.319-42.625, respectively. Whole rock-mineral separates from a granodiorite and a sample of leucogranite from two different plutons within the batholith were analysed isotopically to constrain the age of the least- and most-evolved phases of the body. The granodiorite yields a Pb-Pb age of 373.3 ± 3.6 Ma (MSWD 2.85, 2 sigma) and the leucogranite yields a Pb-Pb age of 365.2 ± 5.4 Ma (MSWD 2.57, 2 sigma). Both ages are considered, within the limits of error, to be identical to the published Rb-Sr whole-rock age of 371.8 ± 2.2 Ma for the batholith.

Regression of the Pb-Pb data intersects the Pb growth curve to give $^{206}Pb/^{204}Pb$ and $^{207}Pb/^{204}Pb$ ratio values of 18.143-18.139 to 15.601-15.600, respectively. These values are close to isotopic values of galena from a granodiorite (18.141, 15.603, 38.209 for $^{206,207,208}Pb/^{204}Pb$, respectively). Thus, the initial composition of lead at the time of emplacement of the batholith was close to the compositions of galena.

The whole-rock isotopic data, when corrected for common lead, plot on a $^{206}Pb/^{238}U$-$^{207}Pb/^{235}U$ diagram and intersect the concordia at near zero and 369 Ma (2 sigma). The distribution of points on the concordia diagram is interpreted to reflect loss of uranium during the post-magmatic stage (i.e., a loss of volatiles). Isotopic data in these uranium-lead and thorium-lead diagrams suggest that uranium has been relatively immobile since the time of intrusion and that the apparent Th/U ratios were generated as part of the magmatic evolution.

Isotopic data ($^{206}Pb/^{204}Pb$ and $^{207}Pb/^{204}Pb$), corrected to the age of intrusion, yield a linear array, interpreted to be a secondary isochron, which we interpret to represent the age of the protolith (669 ± 131 Ma). Potential protoliths include Meguma Group metasedimentary rocks, Liscomb gneisses and Tangier metasedimentary and mafic granulites, but the granulites cannot accommodate the total range of the $^{208}Pb/^{204}Pb$. We suggest that the magma for the South Mountain Batholith is granulite-derived and contaminated with the Liscomb gneisses (with minor contribution from Meguma Group rocks) prior to crystallization.