Lithogeochemical indicators of uranium and tin mineralization in the South Mountain Batholith, Nova Scotia

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The South Mountain Batholith (SMB) of Nova Scotia is a post-tectonic peraluminous granodiorite-granite complex which intrudes Cambro-Ordovician to Lower Devonian metasediments and volcanics. Stratigraphic relations and radiometric dating constrain the time interval between complete crystallization of the batholith (372-361 Ma) and surface exposure through erosion to a few million years.

The main mass of the batholith consists of biotite granodiorite into which are intruded a number of smaller, discrete bodies of biotite-muscovite monzogranite (including porphyries) and dykes and irregular bodies of aplite and pegmatite. Major and trace element and isotopic studies suggest that all these bodies form part of a cogenetic suite. Although fractional crystallization played a major part during the early differentiation process, it cannot adequately explain the evolution of the late stage rocks. The generation of a fluorine-rich fluid phase is thought to have played a major role in determining geochemical trends during the terminal phases of crystallization of the batholith. A para-intrusive suite, consisting of biotite leucogranite, argillized and sericitized granites, albitized granites and albitites as well as various types of greisen, appears to be the product of the interaction of the fluid with residual magma and/or crystalline rocks. The principal Sn-W, Sn-Be, Sn-W-U, W-Mo-U, and U-P-F mineralization in the SMB is spatially and genetically associated with the monzogranite-leucocratic monzogranite bodies, and in particular with para-intrusive rocks found within these complexes. The rapid unroofing of the batholith following its emplacement produced dilatancy and shear fractures which acted as channelways to mineralizing fluids and resulted in mineralized zones in (ex. Gaspereau Lake) or near (ex. Millet Brook) the most differentiated portions of the batholith.

Mean concentrations show an increase in U and decrease in Th abundance from the least differentiated granodiorites to the highly differentiated leucocratic monzogranites. The decrease in Th/U ratio with differentiation (3.0 → 0.5) is accompanied by progressive enrichment in F, Be, Li, Rb, Cs, Ta, Sn and depletion in Sr, Ba, REEs, Sc, Zr, Hf. In the para-intrusive suite elemental correlations often break down and particular elements, for example U versus Th, can show extreme enrichments or depletions. The negative correlation between Th and U as well as Th depletion is not shared by all the plutons. The Davis Lake and Plymouth plutons show a positive correlation and elevated Th abundances in the para-intrusive suites; both bodies are associated with substantial Sn-W mineralization.

Airborn gamma-ray spectrometric maps indicate the presence of a number of other high radioactivity, high thorium bodies in the SMB which have not yet been studied, but should be of interest in mineral exploration. Other lithogeochemical indicators of mineralization include elevated alkali element (Li, Eb, Cs) and fluorine abundances and rare earth enrichment in fluorites.