The northern Appalachian tin metallotect: what conditions led to formation of Canada's only past primary tin producer, the East Kemptville Sn-Cu-Zn-Ag-In deposit?

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Globally magmatic-hydrothermal tin deposits share several common features: (1) mineralization associated with highly fractionated, peraluminous, felsic intrusions and subvolcanic rocks enriched in lithophile elements, (2) deposits are typically concentrated into metallogenic districts (distinguishable by a multitude of mineralized centres hosted by voluminous magmatism of similar character), and (3) shallow crustal levels for mineralization (typically 3–4 km to <0.5–2 km). Outstanding issues in tin deposit models are with the factors that control tin enrichment in the metallotects, i.e., a source for Sn in the magmatic-hydrothermal system may be from crustal melting and assimilation, the mantle, or from the country rock.

The northern Appalachians is one such tin metallotect, as there are widespread lithophile element deposits hosted by Early Devonian to Carboniferous metaluminous to peraluminous igneous rocks. In contrast to typical tin districts (e.g., Cornwall, England; Bolivian tin belt), the peraluminous magmatism in this district is hosted by various tectonic terranes at different paleo-depths and economic tin mineralization is rare. The past-producing East Kemptville (EK) Sn-Cu-Zn-Ag(-In) deposit in the Meguma terrane of Nova Scotia is the most significant of the Sn-mineralized centres. The deposit is hosted in a highly-fractionated, F-rich, leucocratic, peraluminous phase (i.e., EK topazmuscovite granite (EKG)) of the 372.8 ± 3.0 Ma Davis Lake pluton (DLP) that intruded, at 3.5 kbars, the Ediacaran– Cambrian metasandstone-dominated Goldenville Group during the waning stages of the Neoacadian orogeny. The EKG was emplaced along a NE-trending structural corridor that delineates Sn-Cu-Zn-Ag mineralization in southwestern Nova Scotia, some of which records a later mineralizing event at ca. 360 Ma (e.g., Clayton Hill Pluton). Multiple hydrothermal events in the region are recognized at East Kemptville, where molybdenite has been dated (Re– Os) at ca. 376, 354.9 ± 2.0, and 343.7 ± 1.7 Ma across the deposit.

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The DLP is one of several differentiated granites that make up the large ca. 375 Ma South Mountain Batholith (SMB). Despite hosting significant Sn mineralization at EK, the rest of the SMB is relatively unmineralized, as are other peraluminous granites in the Meguma terrane. This study addresses factors that led to Sn-enrichment at EK, and why no appreciable enrichment has been recognized elsewhere in the Meguma terrane. Several factors influence lithophile element enrichment; they include timing of emplacement and evolution of the batholith (e.g., multiple discrete plutons versus one protracted event), the redox and PT conditions throughout melt evolution, and the hydrothermal evolution that resulted in mineralization.

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