

A Geochemical, Isotopic and Fluid Inclusion Study of Pegmatite Formation in a Fluorine-rich Environment: the East Kemptville Sn Deposit, Nova Scotia, Canada¹

D. J. Kontak, W. Halter², A. E. Williams-Jones², R. F. Martin², K. Ansdell³ and J. Dostal⁴

The East Kemptville topaz-muscovite leucogranite (EKL) represents the end product of extreme crystal-liquid fractionation of the 370 Ma Davis Lake pluton, part of the South Mountain Batholith. Infiltration of orthomagmatic, F-rich fluids with $\delta^{18}\text{O}_{\text{water}} = +7$ to $+8\text{‰}$ formed Sn-Fe-Cu-Zn - rich quartz-topaz greisens at $T=480^\circ\text{C}$ and $P_{\text{fluid}}=4$ kbars. Within the deposit, ovoid pegmatite pods ($\leq 1\text{-}2\text{ m}^2$) occur within a few m of the paleo-roof of the magma chamber where the EKL is texturally heterogeneous and contains: (1) crenulate and comb quartz layering, (2) muscovite- and feldspar-rich amoeboid-shaped pods ($\leq 1\text{ m}^2$), (3) rare miarolitic cavities; these features suggest local fluid exsolution occurred with concomitant quenching of the melt. Pegmatites are dominated by quartz (α morphology) and K- and Na-rich alkali feldspar (AF), trace muscovite and rare topaz, cassiterite and molybdenite. The K-rich AF is triclinic ($\Delta=0.89\pm 0.04$), but grid twinning is absent. Geochemical data, including REE, indicate the EKL marginal to pegmatites is identical to the main leucogranite in the deposit, whereas analysis

of pegmatitic AF indicates: (1) bulk compositions of $\text{Or}_{45}\text{Ab}_{55}$ to $\text{Or}_{75}\text{Ab}_{25}$ and $\text{Ab}_{95}\text{Or}_5$; (2) to 1 wt. % P_2O_5 (EMPA); (3) the following abundances (ppm) for K-rich AF - Rb=700-1165, Sr=100-250, Ba=110-225 and K/Rb=90-120; (4) ΣREE and patterns similar to those of EKL, except HREE are depleted and $\text{Eu}/\text{Eu}^*=0.2\text{-}1.2$. Pegmatitic muscovite is depleted in F compared to EKL muscovite (≤ 2.0 wt. % vs. $\leq 4\text{-}5$ wt. %). Stable isotopic analysis ($\delta^{18}\text{O}$) of quartz and AF indicate equilibrium fractionation ($T=425\pm 40^\circ\text{C}$) and $\delta^{18}\text{O}_{\text{water}} = +7.5\text{‰}$ (450°C). A temperature of $300\text{-}325^\circ\text{C}$ is indicated for qtz-cass and qtz-ms isotopic fractionation in a miarolitic cavity. Preliminary fluid inclusion data in pegmatitic quartz indicate $T_{\text{h}}=240\text{-}260^\circ\text{C}$ and salinities of 32-42 wt. % eq. NaCl (enrichment of Na, Fe, Mn, K, Ca, Sr, P from decrepitate analysis), which are similar to the greisen fluids and therefore may not be representative of pegmatitic fluids. Collectively, the data indicate pegmatite formation due to localized exsolution of volatile-rich melt from the magma as a result of fluctuations in P_{fluid} .

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² Department of Earth and Planetary Sciences, McGill University, Montreal, Quebec H3A 2A7

³ Department of Geological Sciences, University of Saskatchewan, Saskatoon, Saskatchewan S5W 0W0

⁴ Department of Geology, St. Mary's University, Halifax, Nova Scotia B3H 3C3