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Distinguishing between magmatic and anatectic origins: the lithium-bearing Revelstoke Pegmatite Field in British Columbia, Canada

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Granitic pegmatites are distinguished from other igneous rocks by their extremely coarse but variable grain size. Pegmatites produce over half of the world's lithium, as well as cesium, niobium, the rare earth elements, and gems. The comparatively recent economic interest in pegmatites has coincided with a revolution in our theories of how pegmatites form. For example, for many years the most accepted idea was that pegmatites resulted from fractional crystallization of granitic magmas. However, the lack of parental granites in many pegmatite fields, coupled with innovations in geochronology, suggested that some pegmatites could form directly from the partial melting of metasedimentary and metavolcanic protoliths, or anatexis. However, we do not know how to determine (1) if a pegmatite is a residual melt of granite magmatism (RMG) or a direct product of anatexis (DPA); (2) how partial melts are concentrated to form pegmatite dikes; and (3) if individual pegmatite bodies and groups or fields formed as a single event or as a series of pulses.

In central British Columbia the 50 km^2 Revelstoke Pegmatite Field (RPF) includes more than 100 lithium-rich and barren pegmatites extending from Boulder Mtn. in the north to Mt. Begbie in the south. Our recent progress suggests that the RPF will be an excellent place to find answers to the above questions. In particular, the exposure on Mt. Begbie is exceptional. In an RMG model, the nearest potential parent to the RPF is the Ladybird granite suite (LBG), exposed ~50 km to the S and situated structurally above the RPF; previous work has suggested a genetic link between the LBG and migmatites in SE BC. In contrast, our Mt. Begbie fieldwork revealed abundant migmatite and perhaps melferite (high strain melt migration pathways), which could be a precursor to the pegmatites in a DPA model, possibly concentrated via a "suction pump model". We are currently using field mapping, petrology, whole rock geochemistry, geochemical modelling, geochronology, and isotope geochemistry to answer the questions outlined above. Deposit models developed from this research will aid in exploration for critical mineral-bearing pegmatites.