Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.27826

Tectonometamorphic evolution of the Galaxy lithium deposit area: implications for the genesis of LCT pegmatite fields in the Superior Province (Quebec, Canada)

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The Galaxy deposit (110.2 Mt @ 1.30% Li_2O; total resources; 43-101, 2023) is located in the metasedimentary Nemiscau subprovince of the Superior craton, immediately to the south of the Lower Eastmain greenstone belt of the volcano-plutonic La Grande subprovince. Mineralization occurs as dikes displaying a relatively simple granitic composition, characterized by the presence of spodumene, micas, tourmaline, garnet and colombo-tantalite. They are subvertical and NNE-trending, forming an ESE-WNW-trending pegmatite field with a strike length of ~1.5 km and a width exceeding 250 m. Individual dikes reach widths of 80 m and lengths of 250 m in the center of the field; their dimensions gradually decrease towards the eastern and western extremities. The Li-bearing pegmatites are located at the northern limit of a larger barren pegmatite dike swarm rooted in a migmatitic dome.

The metasedimentary rocks that host the dikes are affected by a penetrative D_2 E-W-trending foliation overprinted by a D_3 NE-SW-trending crenulation cleavage. The Li-pegmatites cut the penetrative D_2 foliation but show late folding, and dikes emplaced along F_3 axial planes are boundinaged. These structural relationships indicate that regional-scale transcurrent dextral D_3 shearing was synchronous with, and controlled dike emplacement, although no major crustal-scale shear zone was documented in the vicinity of the deposit. The dikes are hosted in a sandstone horizon at the contact with cordierite-bearing wacke and pelitic rocks, in part due to preferential development of extensional fractures in the sandstone as a result of competency contrast. Field observations suggest that the pegmatite field was formed by a succession of key processes, including the formation and evolution of anatectic melts and late transcurrent deformation at the margin of a M_2 cooling migmatitic dome. The formation of structural traps in a competent sandstone unit was instrumental in focusing of the most evolved melts into closely-spaced dikes.