Dating multiple fractionation trends in Li-bearing pegmatites

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Résumé

Southern Ghana hosts a large number of pegmatites, gathered in several fields which have been shown to be geochemically and genetically distinct. Some of the pegmatites are simple, poorly zoned but strongly mineralized in lithium (as spodumene) with poor concentrations of Nb-Ta-Cs, whereas others display more conventional Li-Cs-Ta-type features, with complex zoning and Li-Cs-Nb-Ta-Sn-rich mineral assemblages. We have investigated three of these pegmatite fields using trace element geochemistry of micas and U-Pb geochronology of columbite-group minerals (CGM). Rb/Cs concentrations in primary magmatic micas reveal multiple Rayleigh fractionation paths, and dating of CGM associated with the primary magmatic micas reveals that each of these fractionation paths occurred at different ages spanning ca. 140 Myr. Moreover, our data shows that the oldest pegmatites correspond to poorly fractionated, Li-rich, Nb-Ta-Cs-poor pegmatites, whereas the youngest are the most fractionated, Nb-Ta-Cs-rich pegmatites (up to levels of the major Lithium-Cesium-Tantalum pegmatites worldwide). The distinct fractionation paths can be modeled using different starting Rb and Cs melt compositions that may be attained by direct partial melting of the meta-sedimentary country rocks. The proposed model of formation for this large Li-bearing province involves at least three distinct stages of partial melting and melt extraction at ca. 2170, 2080 and 2030 Ma, which correspond to different heating events of the crust late in the Eburnean orogeny. The produced melt batches evolved independently through fractional crystallization, the spodumene-bearing pegmatites being the least fractionated, and the "true LCT" pegmatites the most fractionated. This implies that abundant Li mineralization does not require strong levels of fractional crystallization.

Mots-Clés: Lithium, pegmatites, Rayleigh fractionation, columbite, group minerals, U, Pb dating

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