Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18286

The origin of Anatectic Lithium-Cesium-Tantalum pegmatites

LORENZO MAGNANI[1], FEDERICO FARINA[1], FEDERICO PEZZOTTA[2], ANDREA DINI[3] AND MATTHEW JASON MAYNE[4]

[1]Università degli Studi di Milano
[2]Museo Civico di Storia Naturale di Milano
[3]Istituto di Geoscienze e Georisorse - CNR
[4]Stellenbosch University

Presenting Author: lorenzo.magnani@unimi.it

Lithium-Cesium-Tantalum (LCT) pegmatites are the most globally distributed sources of Li and Ta, believed to be formed by extreme fractionation of peraluminous granites. However, in recent years this genetic mechanism has been widely questioned due to new geochemical, isotopic and thermodynamic data, thus pointing to a direct anatectic origin of several LCT pegmatites from partial melting of metasediments.

Using a compilation of whole-rock geochemical data available in the literature, we demonstrate that elemental ratios such as Nb/Ta and K/Rb can be used to track the mechanism of formation of this important resource of Li and other metals, discriminating between pluton-related and anatectic LCT pegmatites. The former are extremely fractionated as the connection to their parent granite allows for late stage fluids saturation and rework, while the latter are less fractionated, featuring ratios values close to those of granites, suggesting an origin linked to extreme fractionation of anatectic melts. By applying the proposed classification scheme to literature data of unknown affinity we observe that anatectic LCT pegmatites appear to be much more common than their pluton-related counterparts, contrary to what is commonly accepted.

These findings call for a better understanding on the conditions of metasediment melting that generate Li-rich magma. By means of phase equilibria modeling and trace elements analyses, we identified that cordierite plays the most important role in regulating the Li transfer during partial melting in low pressure migmatites and its absence may determine the production of Li-endowed magmas. Calculated pseudosections highlight a temperature range between 700 and 750°C in which no melt is predicted at high pressure since muscovite is stable, while at low pressure it is consumed forming liquid. This suggests that in the case of isothermal decompression at 700-750°C from middle crustal pressures to approximately 4 kbar melting could start without cordierite formation during fluid-present conditions. This would generate anatectic conditions with important geological implications since they are met in several geological settings characteristic of orogenic accretion that may therefore be targeted in the search for new pegmatitic lithium deposits.