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Anatectic Lithium-Cesium-Tantalum pegmatites formation during low pressure metamorphism of metapelites

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In the contact aureole of the collisional metaluminous Adamello pluton (Italy), non-graphitic pelites reached upper amphibolite facies conditions locally undergoing partial melting. This small-scale migmatitic field is spatially associated with both barren and Lithium-Cesium-Tantalum (LCT)-pegmatitic dikes suggesting a direct link between low-pressure partial melting and generation of Li-enriched felsic melts. Two types of migmatites are recognized: i) orbicular metatexites containing poikilitic Crd crystals and ii) Crd-absent stromatic migmatites with alternating sillimanite-rich layers and K-feldspar-rich leucocratic layers. Phase equilibria modelling reveals that the Crd-bearing migmatites produced around 20 vol.% melt fraction through fluid-absent melting reactions, while the stromatic metatexites produced ca. 35 vol.% of melt during fluid-present partial melting. Peak P-T metamorphic conditions were calculated at 690-700°C and 300 MPa for both rock types. Different leucosome types are found in the two migmatites. In the orbicular metatexites, the leucosomes are compositionally similar to anatectic melts obtained by phase equilibria modelling, suggesting that these in-situ leucosomes did not fractionate. Contrarily, leucosomes in the stromatic migmatites are extremely high in K_2O with their texture indicating that they are K-feldspar-dominated cumulates. This evidence suggests that part of the melt formed in the stromatic migmatites was extracted from the system. Major and trace elements modelling indicates that the composition of the extracted melt lost from the stromatic metatexites is compatible with the chemical features shown by the spatially related LCT pegmatites composition, which are hosted within the same geological formation. Preliminary data show that cordierite, or the absence of it, plays a key role in regulating the lithium transfer during partial melting. Conversely, a model of fractional crystallization starting from the composition of the Adamello tonalites does not allow for the Li enrichment observed in the pegmatites, even at the most terminal stages of differentiation. The studied area shows that fluid-absent and fluid-present melting reaction could coexist at the small scale suggesting that hybrid fluid regimes might also characterize anatectic terranes. Furthermore, our work indicates that anatectic mineralized pegmatites can form through fluid present partial melting of metapelites without them being chemically linked to felsic plutons.