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Petalite alteration products from the Bajoca pegmatite (Central Portugal): a multiapproach for lithium exploration

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Key hydrothermal or supergene alteration minerals are crucial in the remote detection of several mineral deposit types using satellite images. Hydrothermal metasomatic alteration of spodumene and petalite can form eucryptite, albite, K-feldspar and/or micas, and cookeite in more acidic conditions [1, 2]. Moreover, either hydrothermal or supergene alteration of petalite and spodumene lead to the formation of clay minerals like kaolinite, halloysite, pink montmorillonite, and greenish illite-montmorillonite aggregates [1, 3, 4].

This study aims at describing for the first time the petalite alteration products from the Bajoca pegmatite (Central Portugal, Fregeneda-Almendra pegmatite field). Field campaigns allowed to identify white to greenish alteration products with increasing alteration degree respectively, but often with a pseudomorphic character preserving the petalite shape and cleavage. Despite being exploited for more than two decades, hitherto such green clayey assemblage was not described. This alteration was not observed at the surface and is restricted to a sector in the base of the open-pit, with intense fracturing.

A multidisciplinary study was employed to characterize the alteration products through optical microscopy, XRD, SEM-EDS, and reflectance spectroscopy (350-2500 nm). Petrographic studies show that petalite alteration started along the cleavage, fractures, and crystal borders. Fine white mica and pale brown clays were observed in fractures. Compositional data and spectra obtained with SEM-EDS are compatible with white mica and montmorillonite. Eucryptite was also identified. More heavily altered samples show a complete pseudomorph replacement of petalite, widening of the cleavage and quartz precipitation, the formation of cookeite in close association with white mica, and pseudospherulitic illite filling voids. Locally, a later sericitization is observed superimposed on the previous alteration. The clay agglomerates analyzed with XRD consisted of quartz, illite, montmorillonite/nontronite association with occasional muscovite, albite, kaolinite, and orthoclase. The reflectance spectra show the presence of montmorillonite (ubiquitous), illite and/or white mica, and kaolinite (in two samples).

The results seem to indicate at least two stages of petalite alteration: one consistent with the formation of kaolinite in acidic conditions, and another in an alkaline environment that favored illite-montmorillonite [1]. Intense fracturing associated with a known fault-zone was key for fluid circulation. Further investigations are needed to establish the succession of the alteration stages and their relationship with the late-magmatic hydrothermal alteration of petalite to form albite, orthoclase, and eucryptite. Nonetheless, these findings will help to improve satellite detection of lithium-minerals.

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