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# Weathering of natural pyrochlore during hydrothermal and supergene alteration

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Niobium (Nb) is among the most immobile elements during weathering processes [1] due to corrosion resistance of Nb-bearing minerals such as pyrochlore [$A_{2-x}B_2(O,OH)_6(OH,F,H_2O)_{1-y}$] and low solubility [2]. Unusual Nb enrichments reported in laterites worldwide are expected to result from the tropical alteration of primary rocks hosting weathering-resistant pyrochlore [3]. To better understand the effect of alteration on such phases, we have studied three mineralized lateritic profiles from Brazil (Morro dos Seis Lagos, Pitinga and Catalão-I) which formed over pyrochlore-bearing carbonatitic and granitic parent rocks using multi-scale techniques.

Uranium-Pb-enriched pyrochlore of the Pitinga granite exhibits complex chemical variability including veins of columbite resulting from hydrothermal alteration. Transmission electron microscopy has allowed the observation of nanometric secondary Nb phases as veins or alteration borders in association with F-bearing phases (waimirite-(Y) and fluorite) providing evidence for Nb remobilization by fluoride complexation [4].

In the Morro dos Seis Lagos and Catalão-I profiles, average and microscopic analyses of the Nb speciation, obtained by Nb X-ray absorption spectroscopies, evidence the formation of Nb-bearing rutile, brookite, hematite, goethite and cerianite along with the progressive alteration of pyrochlore. Nanoscale examination of pyrochlore reveals secondary products and alteration fronts that provide information on the crystal-chemical mechanisms of pyrochlore weathering and on elements mobility in lateritic context. The nature of these phases depends on the composition of the pyrochlore and on the conditions of weathering.

This set of evidence for pyrochlore weathering challenges the stability of the Nb-oxygen framework of this mineral and questions the immobility of Nb during sub-surface or supergene weathering.

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