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Dissolution of radiation-damaged zircon in lateritic soils

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Abstract

Zircon crystals from lateritic soils at Nsimi, Cameroon, were investigated using electron microprobe analysis (EMPA), transmission electron microscopy (TEM), scanning electron microscopy (SEM), and Raman spectroscopy to determine the extent of radiation damage from alpha-decay events. The soils belong to a small watershed developed on granitic rocks of the Congo craton (2.9 Ga). Interactions with fluids are evidenced by significant CaO (up to 1.5 wt%), Al_2O_3 (up to 2.9 wt%), and Fe_2O_3 (up to 2.9 wt%) concentrations in UO_2 rich regions (0.05 to 1 wt%) of the zircon. Regional heating up to 500 °C, related to the Pan-African orogeny about 0.6 Ga ago, has lead to the recrystallization of the radiation-damaged grains and the formation of a nanoporous microstructure. The correlation observed between the presence of dissolution features and the actual damage state of zircon shows that zircon dissolution occurs under tropical weathering conditions and with preferential dissolution of the highly radiation-damaged regions. Congruent dissolution of zircon and the limited mobility of Zr are supported by the absence of zirconium oxide precipitates in the fractures of weathered grains of zircon.

Keywords: Zircon, Nsimi, laterite, nanopore, zirconium, metamict, radiation damage, TEM