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The Preservation of Denticular Dissolution Textures Through Secondary Mineral Overgrowth and Replacement in Intensely Weathered Regolith

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An understanding of chemical weathering processes and regolith formation can provide insights for the targeted exploration of regolith-hosted critical metal deposits (such as those of Ni and the rare-earth elements [*REE* = La – Lu, Y]). Mineralogical features that are indicative of chemical erosion – such as denticular dissolution arrays and lenticular etch pits – are therefore useful indicators for the conditions of weathering and metal accumulation [1]. However, these textures are seldom preserved when primary mineral assemblages are completely destroyed by intense chemical erosion.

This work characterises primary mineral dissolution textures in intensely weathered regolith from the Kapunda Cu mine, South Australia, which appear to be preserved by mineral replacement. Secondary aggregates of prismatic rhabdophane ($REEPO_4 \cdot 0.66H_2O$) are interpreted through SEM imaging to preserve the outer and inner edges of lenticular dissolution steps and pits, respectively (Fig. 1). Electron backscatter diffraction (EBSD) analysis exhibits two preferential orientations of rhabdophane, which are orthogonal to each other and conform to the curvature of the lenses.

Resultingly, lenticular etch pit morphologies and volumes are maintained through processes of secondary mineral overgrowth and/or replacement. This hypothesis posits that the preferential and orthogonal growth of rhabdophane prisms represents epitaxial precipitation from either the bases or walls of the etch pits, and that concentric prism growth from the base of the pits may be hindered by the pit walls – thus preserving etch pit curvature mechanically.

Overall, these results provide evidence for how primary mineral dissolution textures, which can be used as indicators of weathering conditions and mineral dissolution rates during regolith formation, may be preserved in intensely weathered regolith – even after the primary mineral has been completely destroyed.

[1] Velbel, M.A., 2007. *Dev. Sedimentol.*, 58, pp.113-150.

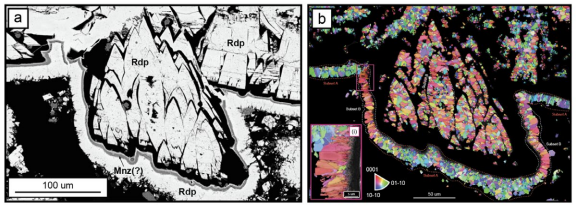

Figure 1: Petrographic analysis of dissolution pit preservation through secondary rhabdophane precipitation by: a) SEM imaging (rhabdophane in white, monazite(?) in grey, void space in black), and; b) EBSD. Note both the complete destruction of the primary mineral, and the two preferential and orthogonal orientations of rhabdophane along its 0001 axis (red) and 01-10/10-10 axes (blue, green).