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The Mt Weld Carbonatite: Heavy Rare Earth Mineralisation from Protolith to Supergene

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The Mt Weld carbonatite (Western Australia) is one of the highest-grade rare earth element (REE) deposits with a recently updated reserve of 29,800 combined tonnes of terbium and dysprosium oxide at up to 4300 ppm Dy_2O_3 [1]. However, the mechanisms governing heavy rare earth element (HREE) enrichment from the giant protolith carbonatite to the upgraded supergene deposit remain poorly constrained.

Primary carbonatite mineralisation is LREE-dominant, averaging ~2 wt% TREO in bulk rock with five-fold enrichment in the regolith; hosted by monazite-(Ce), fluorcarbonates (bastnasite/synchysite) and apatite [2] [3] [4] [5]. Minimal lateral migration during weathering implies regolith REE mineralisation is primarily controlled by the underlying host rock.

Drilling of the supergene profile at Mt Weld has revealed an external annulus of HREE enrichment in the paleoregolith, encompassing the world-class central lanthanide deposit (CLD). This study integrates whole-rock geochemistry, mineral characterization and protolith-regolith profiling on a targeted surface-to-deep-carbonatite 600m EIS funded diamond drillhole. Outcomes aim to characterise and constrain the processes responsible for HREE enrichment in the Mt Weld carbonatite protolith and weathered equivalent. We propose an integrated magmatic-hydrothermal-supergene model for HREE deportment, providing an exploration framework for HREE-enriched carbonatites as a competitive alternative to adsorbed ionic clay deposits.

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