

Primary Rare Earth Elements Mineralization of the World-Class Mt Weld Carbonatite Deposit, Western Australia

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Among the world's largest rare earth elements (REE) deposits is the Mt Weld deposit in Western Australia, where mining activities are currently focused on the laterite formed above a carbonatite bedrock. Because the carbonatite is buried by transported sediments (~20–40 metres thick) and regolith, a recent 1-km-long diamond drill core has provided a novel opportunity to explore the deep lithology and potential mineralisation of the Mt Weld carbonatite. Drilled in the base of the current pit, the first 63 metres of the drill core comprise of regolith and transitional carbonatite and then changes to carbonatite rock. Core logging indicates that the carbonatite body (diameter ~4 km) is zoned, with calcite carbonatite and brecciated phosphorite in the annulus and a ferroan dolomite carbonatite core. In the fresh rock, REE mineralisation is concentrated in the ferroan dolomite carbonatite, with an average of 2.12 wt % REO, higher than >80% of global REE deposits. The dominant REE ore minerals show a clear progression with depth of the core, with monazite predominantly in the fresh dolomite carbonatite from ~70 to 514 m and REE fluorocarbonates from 514 to 806 m, and Ba-Sr-Ca-REE carbonates are observed from 914.6 m to the end of the hole. Monazite occurs as small (<15 µm) fibroradial aggregates replacing apatite and ferroan dolomite, whereas REE-fluorocarbonates are generally >30 µm, bladed aggregates interstitial to the dolomite. Replacement features of the ore minerals show that dissolution and reprecipitation were common processes during the REE mineralisation at Mt Weld, with porosity frequently associated with the mineralisation throughout the carbonatite and indicating that REE ore minerals precipitated from carbohydrothermal fluids.