Magnetite Trace Elements as Petrogenetic Indicators in Exploring Savage River Deposit, Northwest Tasmania

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The Savage River magnetite deposit occurs in the Proterozoic Arthur Metamorphic Complex, in northwestern Tasmania. The deposit type and the ore forming processes of the deposit remain poorly understood. This investigation focuses on the composition of different generations of magnetite to reconstruct the petrogenetic history of Savage River, while also evaluating the critical mineral potential. Testing was carried out on 40 samples collected from two drill holes that intersect the main ore zone in the North Pit of the Savage River deposit. Six different magnetite types were identified based on mineralogy, magnetic susceptibility and associated gangue minerals. The magnetite types were studied in detail using ASD TerraSpec, portable X-ray fluorescence (pXRF), HyLogger, scanning electron microscopy (SEM) and SEM-based automated mineralogy, plus laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). Results suggest an iron oxide-apatite (IOA) type mineralisation based on the discriminant diagrams of Ga vs V, Ti vs V, Ni vs V, and V vs Cr, whereas characteristics of both IOA and Fe-Ti-V deposits are indicated by Ti+V vs Ca+Al+Mn, Ti+V vs Ni/(Cr+Mn) and Ti+V vs Al+Mn. Additionally, Sn vs Ga, V/Ti vs Al/Ti, Ni/Cr vs Ti, and Fe vs V/Ti showed all the magnetite types are likely hydrothermal origin. Three of six Savage River magnetite types have a high vanadium content based on LA-ICP-MS data, with grade up to 0.71% V2O5, suggesting the magnetite precipitated from high temperature hydrothermal fluids. Based on the above results and a comparison of textural and compositional variations of Savage River magnetite with magnetite from worldwide IOA deposits, we suggest that Savage River has characteristics of an IOA style deposit hosted in a Fe-Ti-V oxide system with a vanadium critical metal potential.