Extraction of gallium from a primary ore deposit in Western Australia

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# ABSTRACT

As global markets pivot towards renewable energy and advanced technologies, the demand for critical minerals has surged in recent years. This has particularly played an important role in the global production of gallium which has increased by 7.4% per annum over the past 40 years. Gallium plays a vital role in the production of semiconductors, high-efficiency LEDs, solar panels, and emerging technologies such as 5G infrastructure and electric vehicles. Despite its importance, gallium is almost exclusively produced as a byproduct of bauxite and zinc processing, with minimal consideration during mine planning or metallurgical optimisation. This is largely due to its low natural concentrations and complex geochemistry, which make recovery both technically challenging and economically marginal under conventional processes. In addition to the challenging recovery of the metal, China’s overwhelming dominance of gallium production, currently accounting for around 98% of global output, is further restricting its availability. Recent Chinese export restrictions have also served as a wake-up call, intensifying concerns about, the impact this could have on strategic technological and sustainable advancement as well as supply chain vulnerability and the need to diversify production sources for gallium and other critical minerals.

This study was therefore employed to investigate the feasibility of extracting gallium as a primary product from an ore deposit in Western Australia. Due to gallium’s particularly low enrichment levels, this research could pose a significant step forward in feasibly recovering low-concentration critical minerals from ore deposits. Further, by treating gallium not merely as a byproduct, but as a valuable, strategically important resource, this research supports the development of more holistic and future-facing extraction models that enable the design of metallurgical processes that are both resource-efficient and align with growing market demands and supply chain resilience. The outcomes aim to inform both industry practice and policy, contributing to Australia's ability to lead in the responsible and resilient production of critical minerals.