CLIENTS

Trevor Beardsmore (Trevor.BEARDSMORE@dmirs.wa.gov.au)

Paul Duuring (Paul.DUURING@dmirs.wa.gov.au)

PROJECT TITLE

Estimating Western Australia's potential geological stocks and values of "critical minerals"

PROJECT OBJECTIVES

- Determine whether there are predictable relationships between abundances of metals in mineral deposits that might permit the estimation of unknown stocks of "critical minerals" using known stocks of associated elements;
- If so, estimate potential endowment and value of particular "critical minerals" in Western Australia

DATA DESCRIPTION

The use of (at least) two databases will be required:

OSNACA (Ore Samples Normalized to Average Crustal Abundances) - A database of c. 1200 geochemical analyses from more than 530 mineral deposits from around the world. The Database comprises two main tables: (a) sample location and associated metadata, including classification into ore deposit type; (b) sample geochemical data, for up to 62 elements (Brauhart and Hagemann, 2011).

MINEDEX – the Geological Survey of Western Australia (GSWA) spatial and textual database that provides comprehensive data on mining and exploration sites and projects in WA, including information on mineral deposit endowment (historical production and current resources). (http://www.dmp.wa.gov.au/Mines-and-mineral-deposits-1502.aspx)

BACKGROUND

Critical minerals are non-fuel commodities (generally metals) that nations deem essential for their manufacturing industries, for which there are no ready substitutes and supply chains are vulnerable to disruption (e.g. USA — Petty, 2018; EU — European Commission, 2020; India – Gupta *et al.*, 2019). The Australian Commonwealth Government identifies 24 'priority' critical minerals or mineral groups that are now, or can possibly be, mined locally and used domestically and exported, to use in manufacturing of advanced electronics, and "green" generation and storage technologies to facilitate the transition to a 'low-carbon' world (Austrade-DIIS, 2019, 2020; see Fig. 1).

Western Australia is well placed to capitalize on existing and projected increasing demand for critical minerals. The State is already a significant producer of cobalt, lithium, manganese, rare earth elements (REE), tantalum, titanium and zirconium. It also has some known — but undeveloped — resources of antimony, chromium, gallium, graphite, hafnium, magnesium, niobium, platinum group elements (PGE), potash, silica and vanadium. Western Australia presently has no defined resources of other critical minerals such as beryllium, bismuth, germanium, helium, indium, rhenium and scandium, but is considered prospective for the types of mineral deposits likely to contain them, either as primary or significant accessory components of mineralization (Fig. 1).

Critical minerals are commonly minor or trace components in mineral deposits that are usually mined for other metals (e.g. lead, zinc, copper, gold, nickel). In such cases their abundance is rarely determined, but they are commonly expelled in mine residues, or provided without payment as part of the ore concentrates sold to third parties, thus representing a potentially significant loss of revenue for mining companies and the State.

It would be useful if the potential geological stocks and values of critical elements in Western Australia could be estimated (including uncertainties). This might be possible if (a) there is a predictable relationship between known abundances of (mined) minerals/metals and the unknown "critical minerals"; and (b) the mined minerals endowments are also known. Some preliminary studies of global or Australia-wide resources for particular minerals/metals have been recently published, that may provide guidance (e.g. Werner *et al.*, 2017a,b; Yellishetty *et al.*, 2017; Kelly *et al.*, 2021).

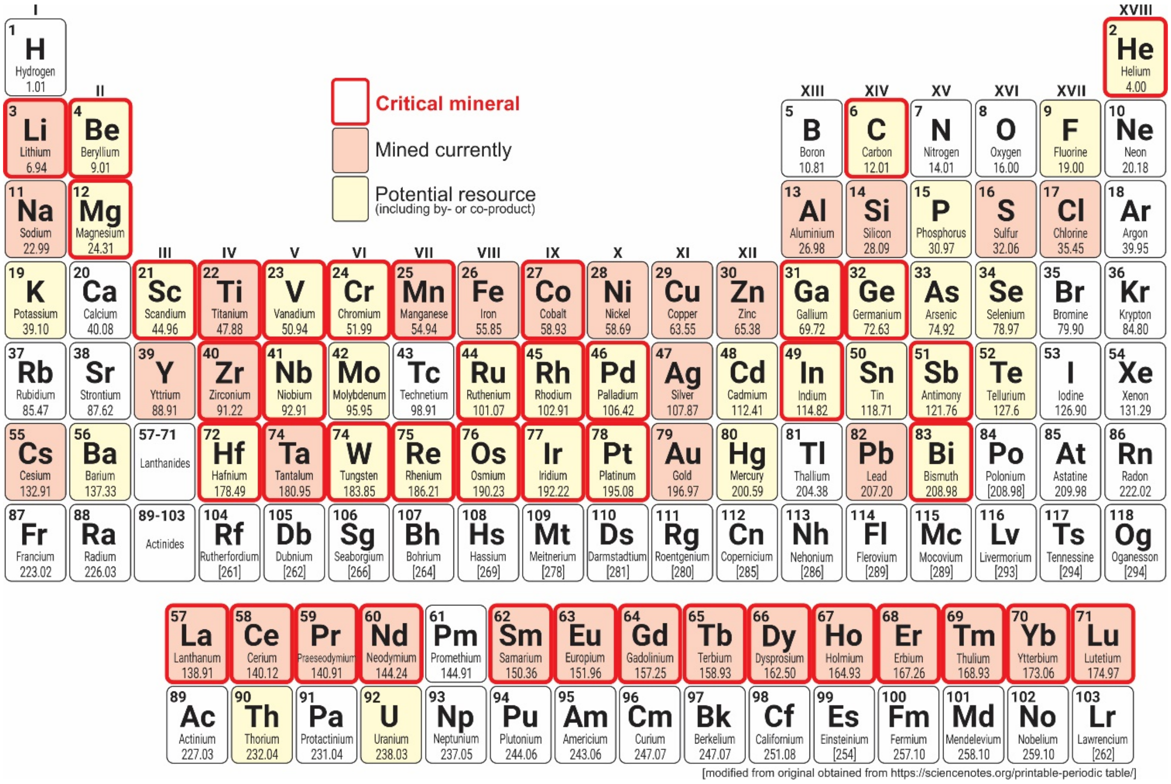

Figure 1. Mined and prospective mineral commodities in Western Australia, with critical minerals highlighted.

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