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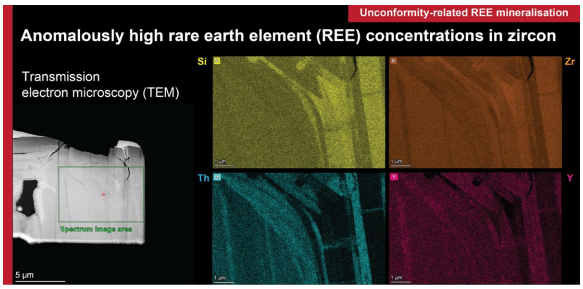

Anomalously high rare earth element (REE) concentrations in zircon: Implications for mineralisation in unconformity-related REE deposits

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'Critical minerals' represent a subset of minerals that are of growing concern, due to potential supply risks and projected demand increases across a wide range of applications and technologies. The transition to renewable energy is underpinned by technologies that are more critical mineral intensive than fossil fuel incumbents, and are expected to undergo accelerated growth over the coming decades [1]. Australia is well endowed with resources and has a high prospectivity for critical minerals, notably rare earth elements (REEs). The provision of REEs by Australia will elevate global supply risks associated with geopolitical uncertainty [2].

Zircon ($ZrSiO_4$) is an important mineral found in many rocks typically used for geochronological isotopic dating, due to its chemical and physical stability. Zircon is also an important reservoir for U, Th and Hf as major element components, and REE as minor components. However, recent work has suggested that zircon may not be as stable and durable as previously thought due to internally induced radiation damage over geological time, and trace elements may play an important role in diffusing into the zircon resulting in chemical modification [3]. Our preliminary research on zircon chemistry from a known unconformity-related REE deposit at Browns Range, Western Australia suggests that zircon may be an important host and liberator of REE. Anomalously high concentrations (weight percent levels) of REE in zircon (determined by EPMA, LA-ICP-MS and TEM; Figure 1) were observed in the basement rocks underlying the unconformity-related REE deposit at Browns Range. This suggests the inventory of REE in zircons may be a possible source of metals for forming REE orebodies. The implications of this research are, (i) understanding the role trace elements (i.e., REE) play in diffusing into zircon resulting in chemical modification; (ii) elucidating whether zircon may be an being an important host and liberator of REE; and (iii) determining the prospectivity of zircon as an exploration tool for locating and identifying REE deposits in Australia, and globally.

[1] Garnaut (2014), *Australian Economic Review* **47**(4): p. 492-508.

[2] Spandler et al., (2020), *Earth-Science Reviews* **207**: p. 103219.

[3] Kovaleva et al., (2017). *Chemical Geology* **450**: p. 183-198.