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Geochemistry in critical mineral deposits study

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The utility of (geo)chemistry in studying the origin of mineral deposits lies more in narrowing down potential outcomes rather than directly answering the more complex, underlying questions (Krauskopf, 1979). This process of elimination and defining boundaries is critical in studying the genesis of mineral deposits that provide metals and minerals crucial for the development of modern society, including rare earth elements, cobalt, lithium, graphite and germanium. This is because this group of metals and minerals are often sourced from unconventional, unfamiliar and under-examined mineral deposits that attribute to their geological scarcity. This work will use three case studies, including rare earth elements in the hydrothermal-metasomatic deposits in Sweden, germanium in the carbonate-hosted lead-zinc deposits in Ireland, and cobalt in the sedimentary-rock hosted copper deposits in DR Congo, to highlight the fundamental role of geochemistry in identifying more likely geological scenarios and processes in the formation and concentration of critical metals in mineral deposits. We emphasize the value of geochemistry study in answering fundamental research questions in critical mineral deposits study, such as the source of ore-forming materials, transport pathways and trapping mechanisms. However, we also acknowledge the challenges in this under-explored field that underscore a holistic approach of integrating geological, geochemical and geophysical studies to ‘attack deeper questions’ of ore genesis in order to develop a conceptual framework for critical minerals deposit model to help guide exploration.

Krauskopf, K.B. (1979) Introduction to Geochemistry. McGraw Hill, New York, p410.