

Picking low-hanging mineral fruit and revising the critical minerals inventory

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Global economies have been reliant on “base and precious metals” for centuries; even so, in recent times mining has become an increasingly unpopular activity in westernized countries. Extraction of base and precious metals traditionally has focused on one or two commodities supplied by a mine, extracting the richest ore, and leaving unsightly and polluting waste heaps and tailings in the wake.

In the last decade, however, greening economies demand a sustainable supply of so-called critical metals (minerals), reshaping attitudes about the security of sustainability and requisite need for mining. More efficient and more complete extraction technologies that recover all useful metals are essential. A nation's critical metals list is continually in flux. Shaping that list are a nation's reserves and geologic potential for new discoveries, a nation's technology for extraction and the associated supply chain for that process, and for critical metals that are not “in-nation”, the stability of supplying partners or supply risk. Developing technologies for multi-element recovery from industrial mining waste is an essential step forward, thereby picking the low-hanging mineral fruit and improving the environment in a single action. Sharing that technology with less developed countries is necessary for a global green economy, as humanity shares but one planet.

Source rocks and exploration strategies for critical minerals and metals must be radically reassessed. We must look beyond traditional carbonatites, pegmatites, and hydrothermal ore deposits for critical metals. We must exploit minerals containing multiple critical metals, such as sphalerite. Although mining *deep-sea* sediments presents societal and environmental challenges, a rich archive of equivalent *on-land* sedimentary rocks, e.g., shales and slates, offers a source of rare earth elements. Nations that once thrived on coal mining have spoil heaps of shales and sub-grade coal that should be a high priority for critical metal mining and clean up. Processing of hydrocarbons involves scrubbing metals and sulfur from organic material. These reservoirs of scrap hold precious critical metals for capture. Fundamentally, concentrations of critical metals housed in Earth's minerals and rocks are poorly known. Establishing a revised inventory and new strategies for recovery are essential.