What impacts does the availability of water resources have on the future development of mineral resource productions?

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Introduction

The global demand for transition metals like copper, lithium, and nickel is rising, driven by the energy transition and the growing need for critical raw materials. At the same time, water scarcity is becoming an increasingly pressing issue [1], with climate change altering precipitation patterns and intensifying competition for water resources. Mining operations rely heavily on water for extraction, processing, and dust suppression, making them particularly vulnerable to these changes [2] (see fig. 1.).

Research Organisation & Methodology

This research follows a two-step approach.

First, a hydrogeological and hydrological analysis was conducted to understand how global water resources will evolve in the future under varying climate scenarios. This analysis focuses on identifying regions where increasing water stress could pose challenges to mining operations, as shifting water availability may limit the viability of mineral extraction in these areas.

The HyIR (Hydrological and Industrial Resilience) global-scale tool was developed to assess these risks by integrating climate projections from CMIP6, along with data on river networks, aquifers, groundwater storage, and human-made water reservoirs. By combining these datasets, HYIR generates spatiotemporal assessments of water availability, providing critical insights into how climate change will shape water scarcity. This tool is essential for understanding how future water stress may affect industrial activities, particularly mining, in regions vulnerable to reduced water supply.

In the second stage, the focus shifts to quantifying water use in mining operations [3], which varies significantly across different mines. To account for this variability, mines will be classified by mineral type and extraction method, allowing for the development of a model to estimate water use for each classification. Additionally, the impact of desalination and recycling on a mine's water footprint will be incorporated into the model. By integrating these insights with a global database of mineral deposits, this research aims to identify regions most vulnerable to water scarcity and determine which minerals are likely to be most affected on a global scale.

Perspectives

Once the second stage of the research is achieved, it will be integrated with HyIR to assess:

- Which mineral deposits may become unextractable due to water constraints.
- The financial implications of water-related costs, including desalination and alternative water sourcing.
- The broader effects on global mineral supply and production shifts.

These findings will offer valuable insights into the economic and industrial impacts of water scarcity on mining, while also informing strategies for sustainable resource management.

Conclusion

This research presents a global-scale approach to assessing water-related risks in mining. The findings will identify the impact of water stress on the future of mining, supporting more sustainable mineral extraction in a changing climate.

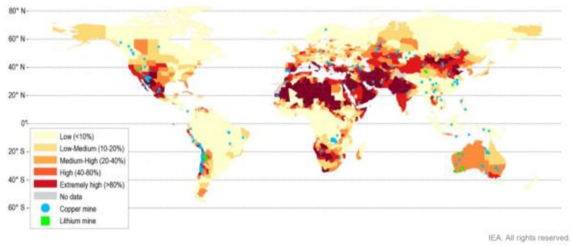

Fig. 1. Overlay of lithium and copper mines on the map of water stress levels in 2020. Source: IEA

References

[1] Mekonnen MM, Hoekstra AY, 2016, Four billion people facing severe water scarcity, 10.1126/sciadv.1500323

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[3] Meißner S, 2021, The Impact of Metal Mining on Global Water Stress and Regional Carrying Capacities—A GIS-Based Water Impact Assessment, 10.3390/resources10120120