Water security, mining & mine reclamation

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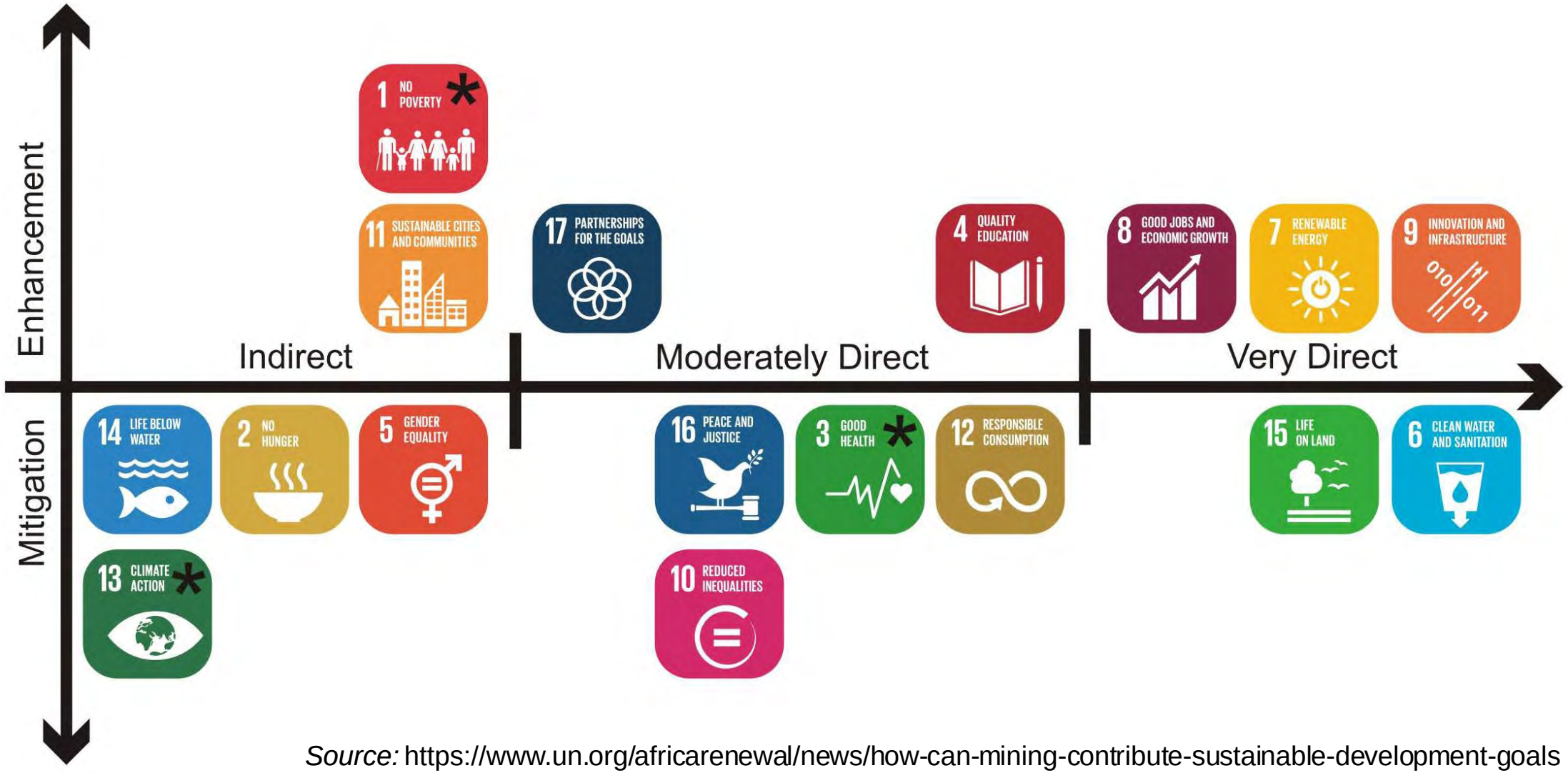
Abandoned Pb-Zn-Cu Tailings, Treaty 6 Territory, SK, Canada (Credit: M.B.J. Lindsay)

Mining is intricately connected to all UN SDGs...



Source: https://www.un.org/africarenewal/news/how-can-mining-contribute-sustainable-development-goals

…including groundwater and surface water resources.

- contamination
  - waste materials: geochemical reactions, contaminant leaching
  - extraction/processing: effluent discharge, atmospheric emissions
- consumption
  - extraction/processing: water use in extraction and processing

Figure 14. Summary of metals and mining industry freshwater impacts along its value chain. Selected hotspots are the regions frequently cited in the literature.

Value Chain	Practices	Externalities	Freshwater Impact	Selected Hotspots
Extraction	Mining of gold, coal, and other metals	Acid mine drainage, metal leaching	Ecotoxicity, human health impacts, ecosystem impacts	Portugal, Iran, Canada
		Water consumption, extraction	Water stress, groundwater depletion, social conflict	USA
Processing	Smelting	Metal pollution	Ecotoxicity	

Source: Famiglietti et al. (2022) Global Assessment of Private Sector Impacts on Water. CERES/GIWS/VWI, 93 pp.

Cerro Colorado Cu Mine, Spain (Credit: M.B.J. Lindsay)

Mining produces resources that society demands…

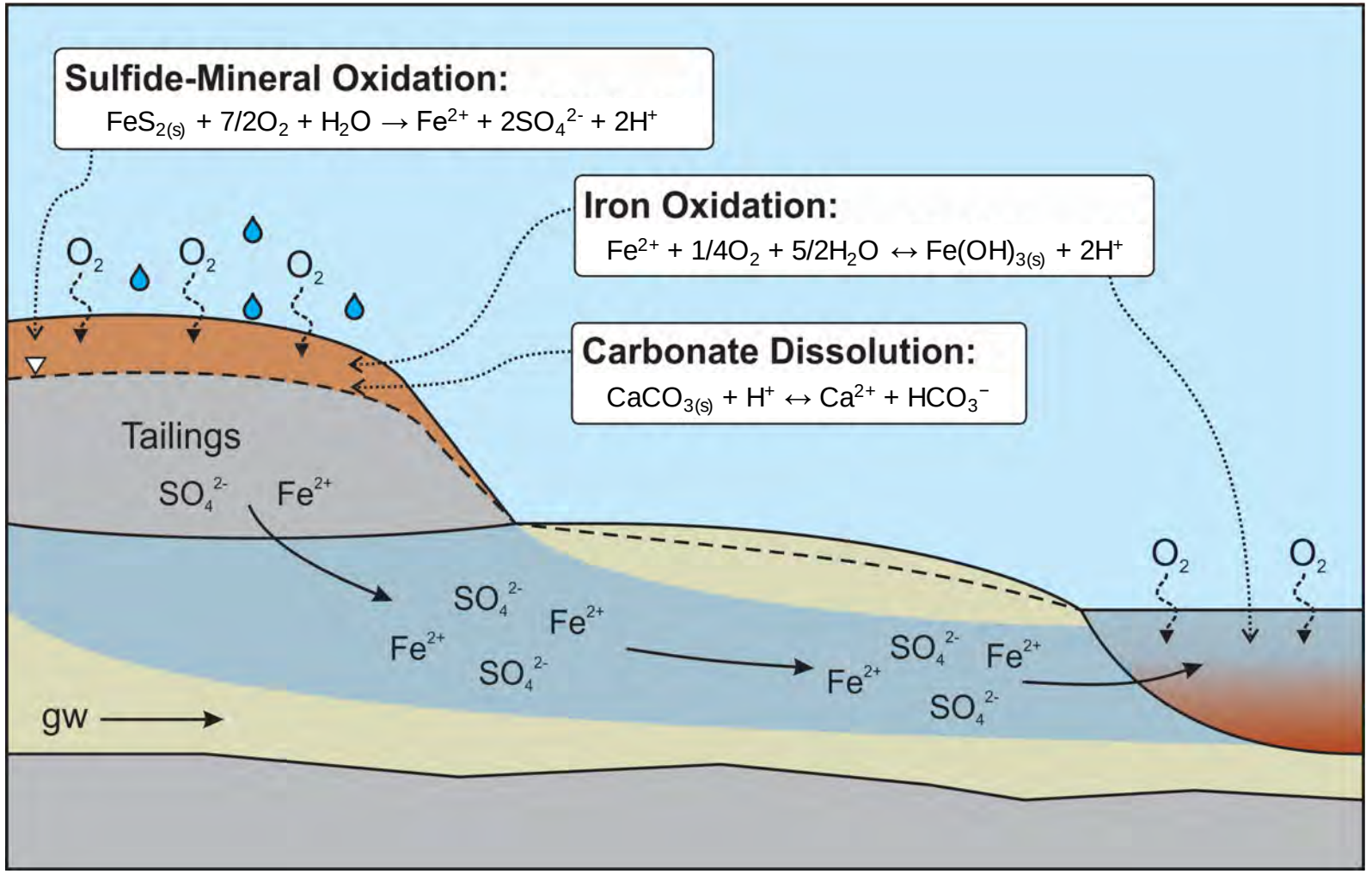
Historical Mine Wastes, Minas de Riotinto, Spain (Credit: M.B.J. Lindsay)

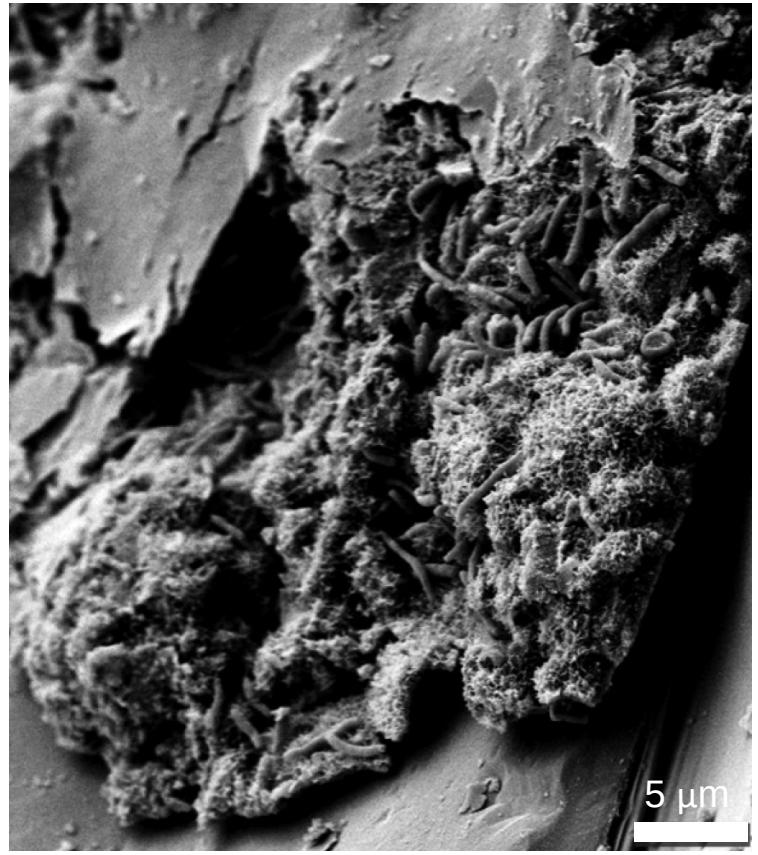
…and generates a wide range of waste materials…


Waste Rock Deposit, Antamina Cu-Zn Mine, Peru (Credit: S. Blackmore)
…with varied physical and chemical characteristics.

Former Sherridon Mine, Treaty 5 Territory, MB, Canada (Credit: M.C. Moncur)

Acid mine drainage is a common water quality risk...





Dockrey et al. (2014) *Minerals* 4: 170–190.

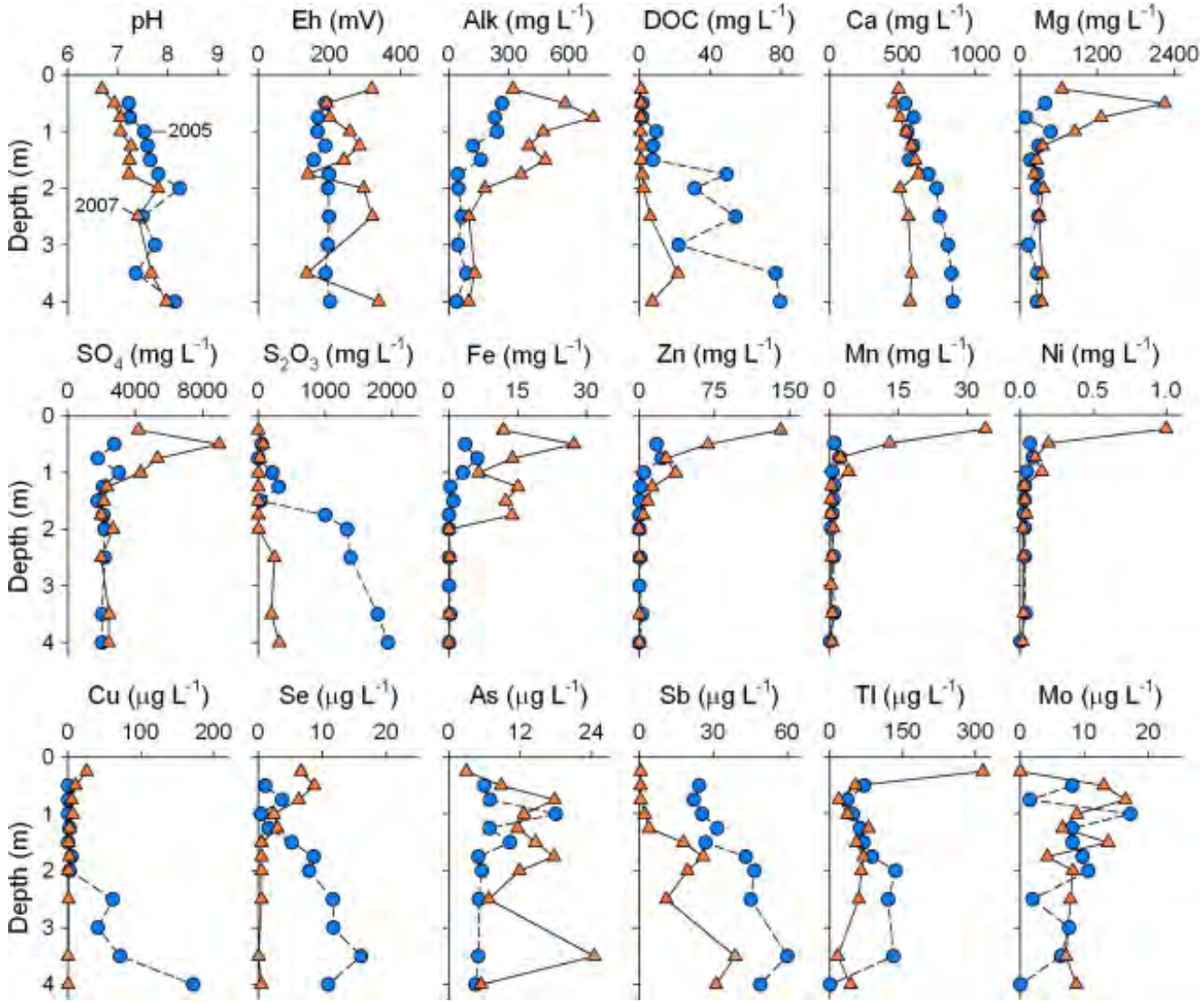
Acid mine drainage is a common water quality risk...

…but metal contamination is not limited to acidic conditions...

Greens Creek Pb-Zn-Au-Ag Mine, AK, USA (Credit: M.B.J. Lindsay)

…but metal contamination is not limited to acidic conditions...

- elevated concentrations common in circumneutral pH mine waters
- dependent upon several factors:
  - mineral association
  - element chemistry
  - geochemical conditions



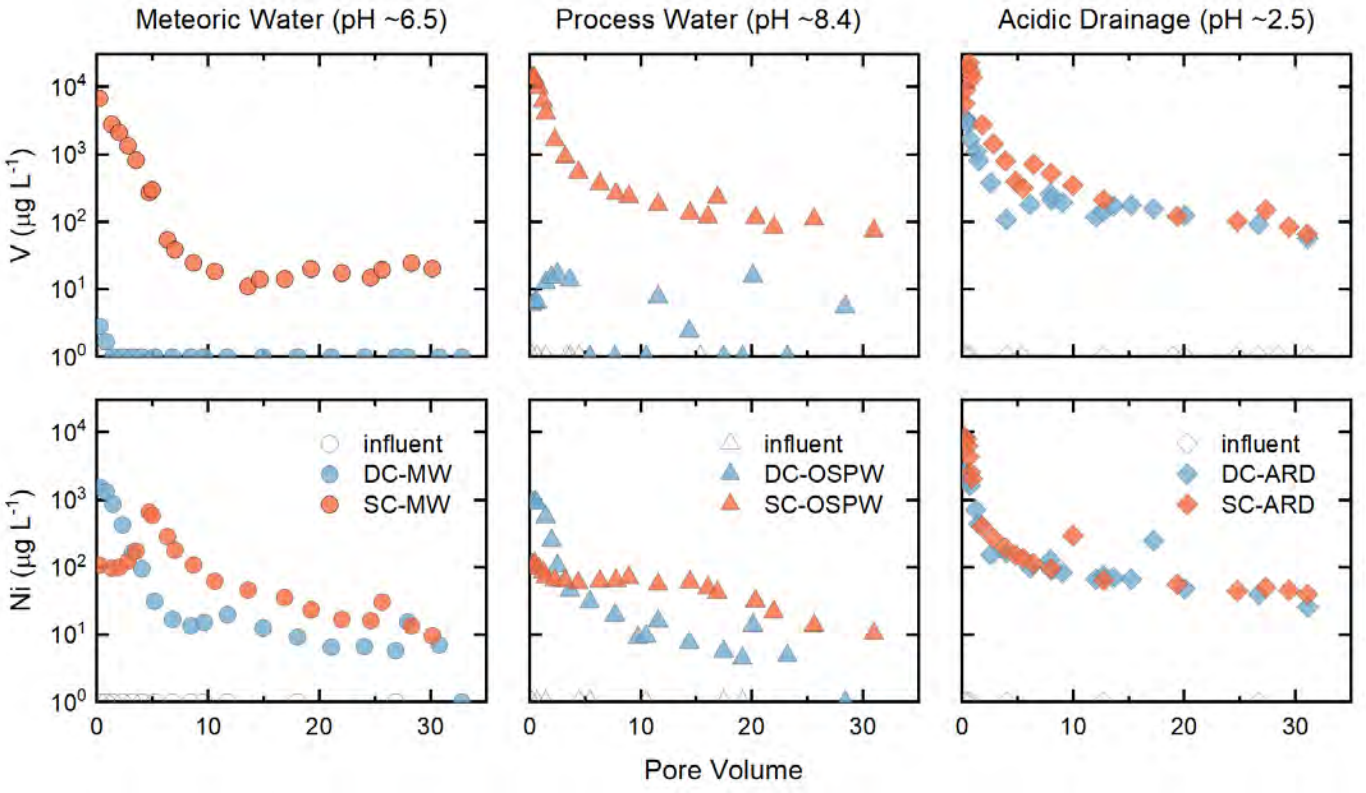
Lindsay et al. (2009) *Appl. Geochem.* 24: 2212–2221.

…or metal mining operations.

Petroleum coke deposit, oil sands mine, AB, Canada (Credit: M.B.J. Lindsay)

…or metal mining operations.

Vanadium and nickel release from fluid petroleum coke of particular interest.



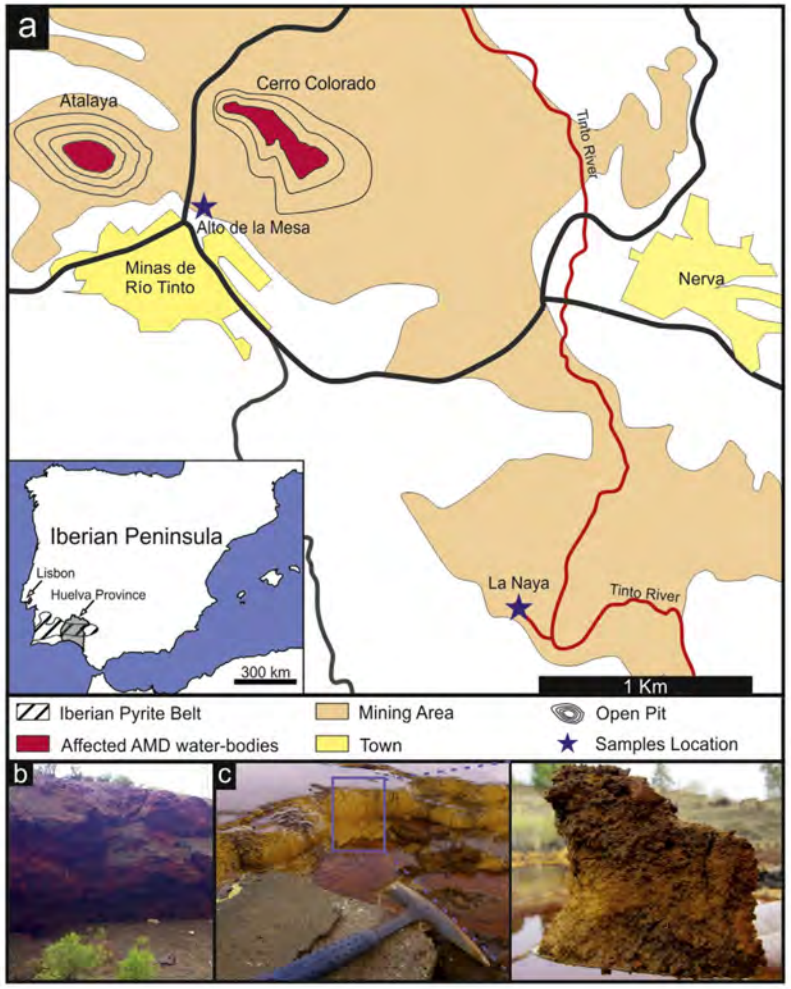
Abdolahnezhad and Lindsay (2022) *J. Contam. Hydrol.* 245: 103955.

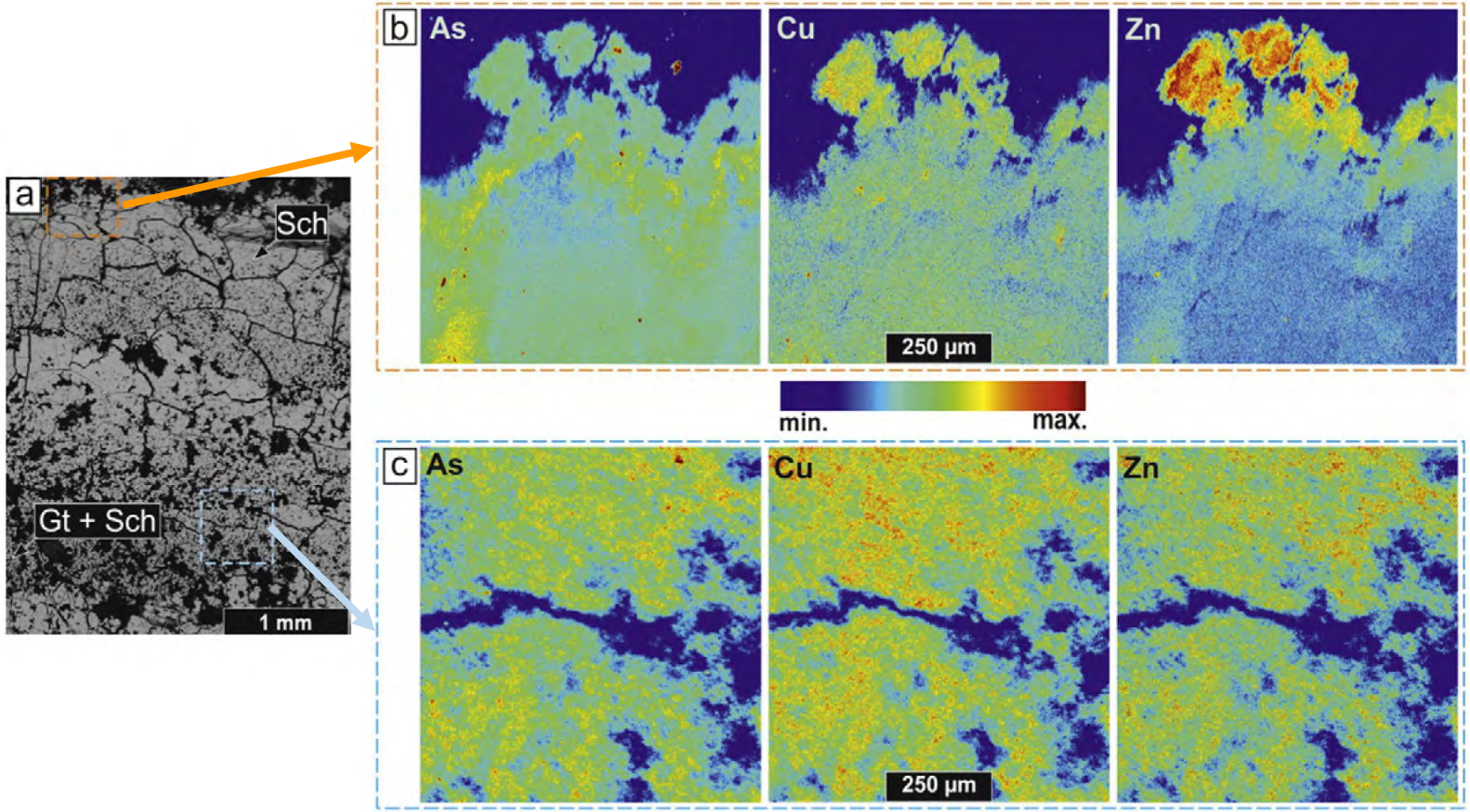
Metal transport is often controlled by metastable precipitates...

Iron Precipitates, Minas de Riotinto, Spain (Credit: M.B.J. Lindsay)

Metal transport is often controlled by metastable precipitates...

Iron(III) phases are important sinks for metal(loid)s in mining environments.



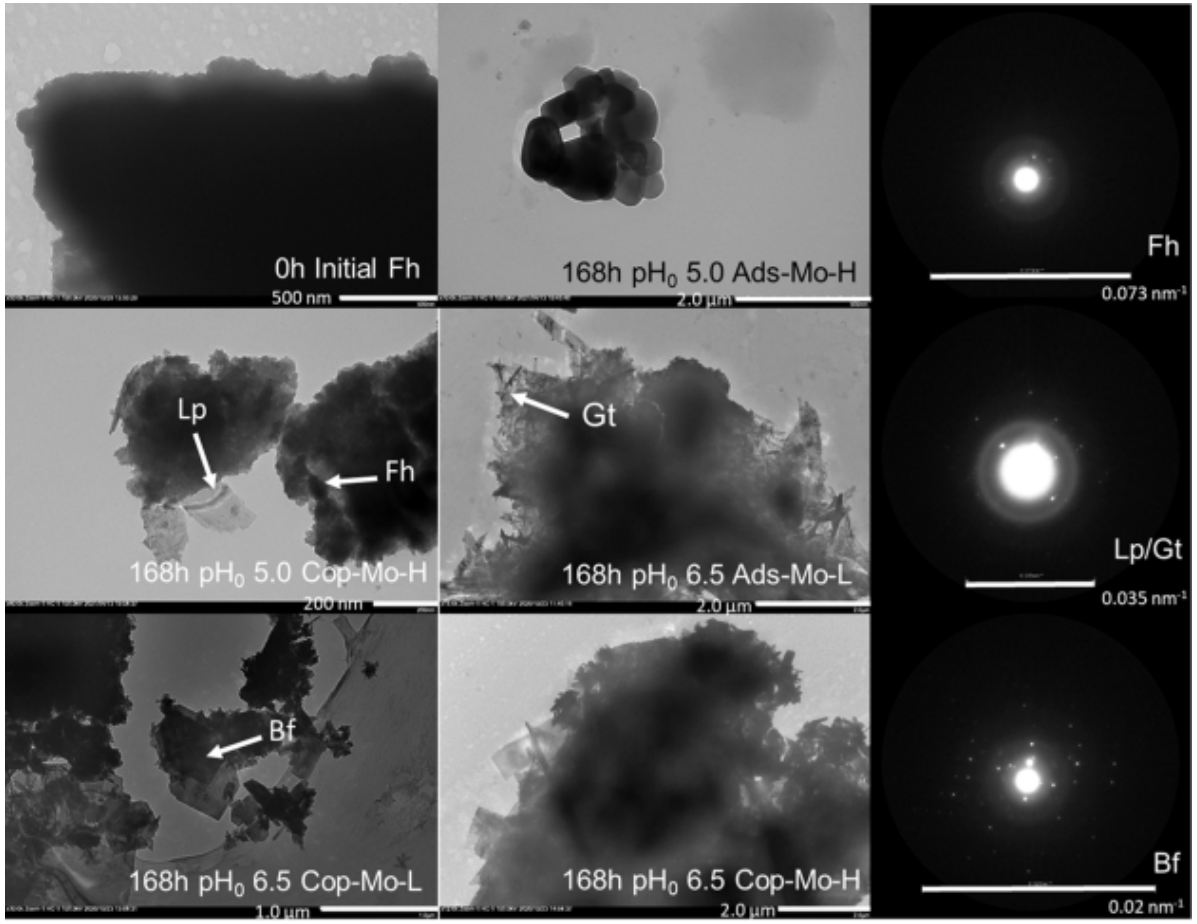


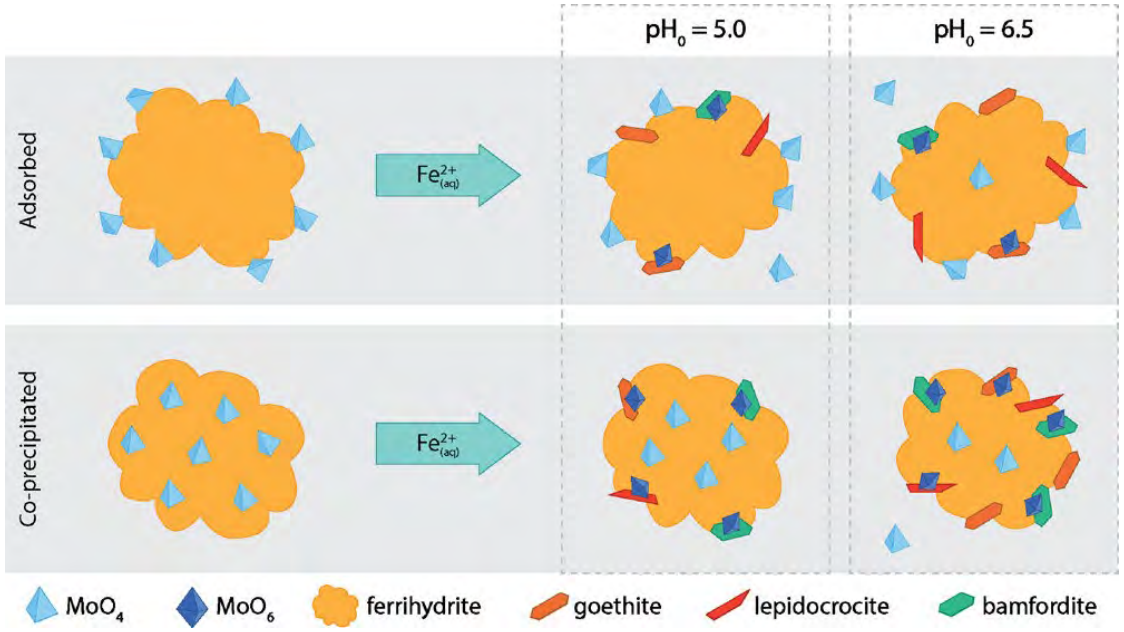
Cruz-Hernández et al. (2016) *Catena* 47: 386–393.

Abandoned Pb-Zn-Cu Mine, Treaty 6 Territory, SK, Canada (Credit: M.B.J. Lindsay)

…that present challenges for mine reclamation.

Changing geochemical conditions can promote metal(loid) repartitioning.





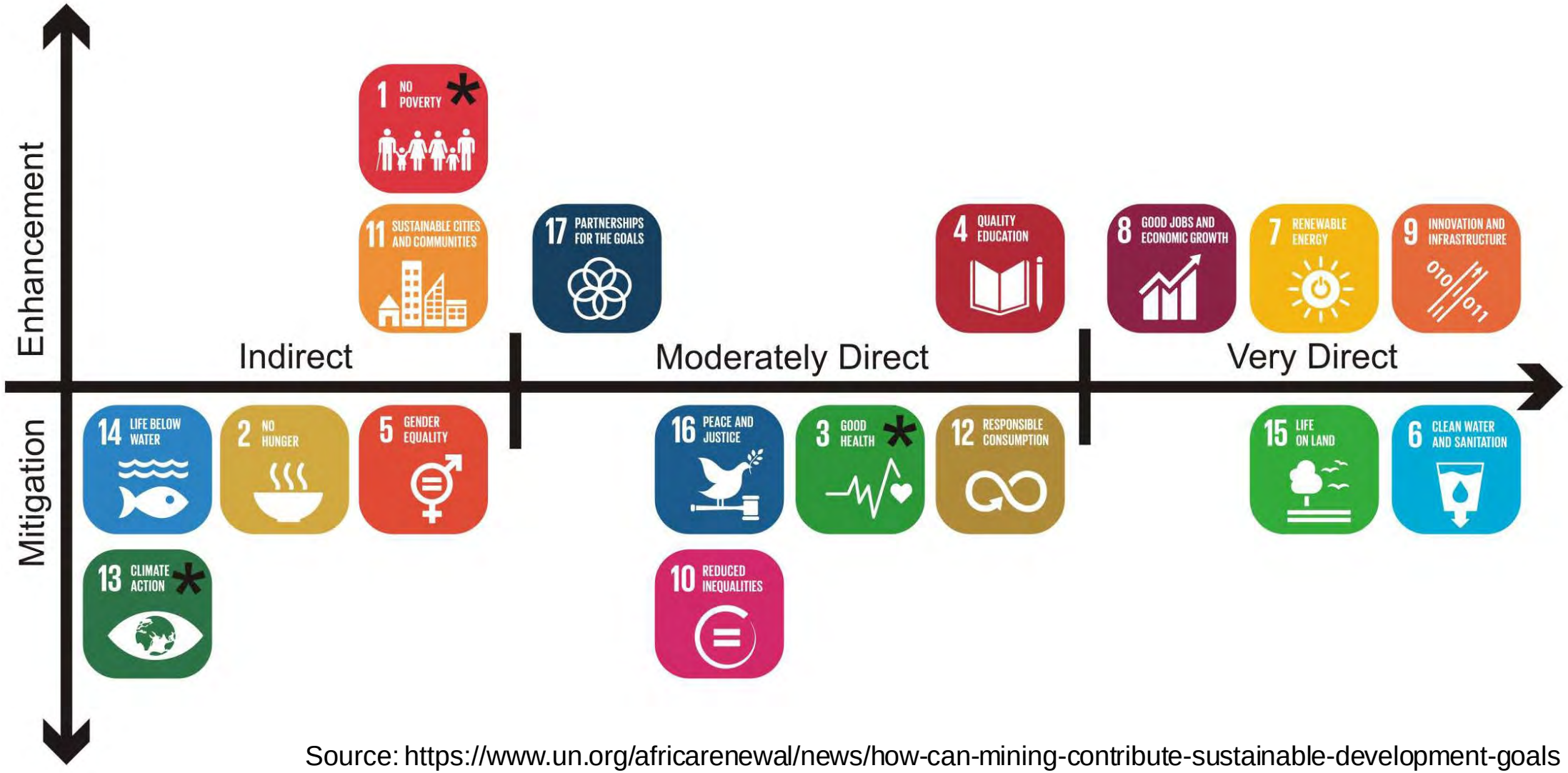
Schoepfer et al. (2021) *ACS Earth Space Chem.* 5, 2094–2104.

…that present challenges for mine reclamation.

Effective mitigation and reclamation approaches are critical…

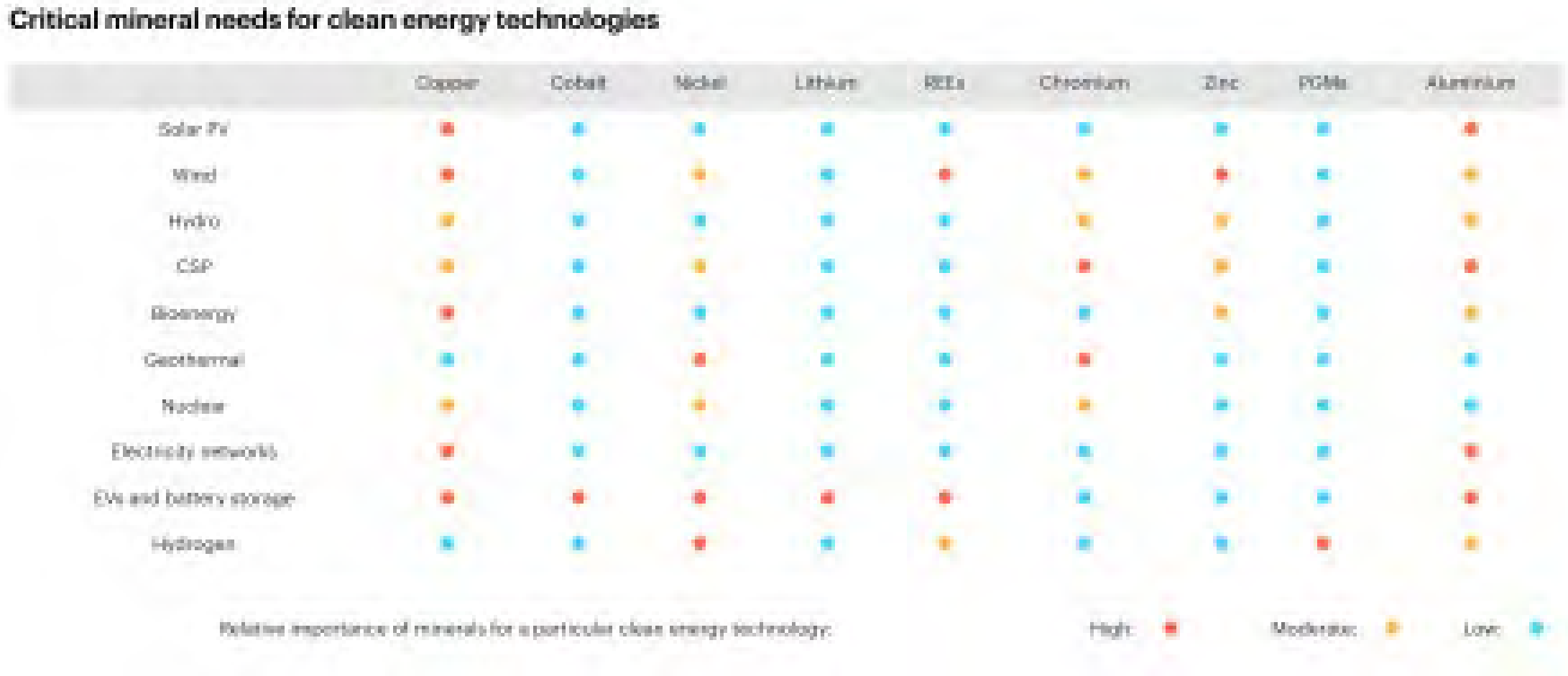
Former Sherridon Mine, Treaty 5 Territory, MB, Canada (Credit: M.C. Moncur)

…for realizing the UN SDGs…



Source: https://www.un.org/africarenewal/news/how-can-mining-contribute-sustainable-development-goals

…including the transition to “clean” energy technologies.



Source: IEA (2021) The Role of Critical Minerals in Clean Energy Transitions. https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/mineral-requirements-for-clean-energy-transitions

How do we balance resource extraction, water security, and SDGs?

Significant research, training and engagement needs and opportunities!

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Acknowledgements

Group Members:

- Mojtaba Abdolahnezhad (MSc, 2020)
- Dr. Pablo Cruz-Hernández (PhD, 2016)
- Dr. Jullieta Lum (PDF, 2020–2021)
- Dr. Valerie Schoepfer (PDF, 2019–present)
- All trainees and staff over my past 10 years at USask!

Collaborators:

- Dr. David Blowes, University of Waterloo, Canada
- John Dockrey, Lorax Environmental Services, Canada
- Dr. Uli Mayer, University of British Columbia, Canada
- Dr. Michael Moncur, University of Saskatchewan, Canada
- Dr. José Miguel Nieto, Univsidad de Huelva, Spain
- Dr. Carol Ptacek, University of Waterloo, Canada
- Dr. Rafael Pérez-López, Universidad de Huelva, Spain

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