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# Selective leaching of technology metals using Natural Deep Eutectic Solvents

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Decarbonisation of the global economy will require an immense upscaling in the procurement of technology metals (including Cu, Co, Ni, W and REE) which are irreplaceable components of modern Net Zero technology, including batteries, photovoltaic cells and wind turbines. Many such metals are also designated by the EU as Critical Raw materials and therefore have high economic value combined with a high supply risk. It is therefore vital that new technology is developed to enable continued procurement of such metals whilst also limiting environmental impact of such activity. Mine wastes also offer new opportunities for critical metal procurement by diversifying technology metal supply chains.

Traditional hydrometallurgical methods often involve either high temperatures, or ex-situ leaching using mineral acids (such as > 1M $H_2SO_4$), which can present significant human health and/or environmental impacts. In this work, we investigate the application of a new generation of 'green' Natural Deep Eutectic Solvents (NDES) for the dissolution of Co, Ni, Cu, and Mn from low grade mixed sulfide ores and tailings.

For the first time, we report that selective leaching of technology metals from sulfide ores and tailings can be achieved using ChCl- and Betaine-based NDES. Our experiments have established optimal conditions for Co, Cu and Mn leaching in preference to gangue minerals, as a function of temperature, leaching duration, water content of the NDES, and solid-liquid ratio. Results show that whilst leaching efficiency is enhanced at greater temperature, dissolution of >80 wt.% Co, Cu and Mn can be achieved at relatively low temperature (<30°C). Overall, the results provide new insight into the potential of NDES to support a new environmentally compatible process for metal extraction from sulfide ore and tailings material in order to meet the critical material demands for the future.