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Towards a new economically viable CCUS process ? Producing clean H2 by solid storage of CO2 into mine slags

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Though mine slags are nowadays being recycled for numerous applications, particularly as building materials materials in the construction industry, one of its potential usage remains undervalued. Whether in mafic and ultramafic geological lithologies, mine wastes have the mineralogical and chemical properties to store CO_2 through the formation of Calcium or hydrated magnesium carbonates, while producing H_2 through the oxidation of iron when reacted with fresh or seawater. Such a reaction typically occurs as a by-product of serpentinization. Though this geo-inspired process has recently been suggested to work in-situ within geothermal fields [1] by using the geotherm, it has also been shown to work ex-situ at the lab scale [2,3] around 250°C. It could therefore prove cost-efficient at the industrial scale by recycling the heat used within a metal extraction plant.

This study will review the various iron-rich mining areas where such a process could be applied (such as New Caledonia, Western Canada, Australia or Minnesota), the reaction pathways that would take place, and the maximum yield of simultaneous H_2 generation and CO_2 mineral storage that could be expected. We will also investigate the physico-chemical parameters (reactive surface, temperature) limiting the kinetics efficiency of the reactions. Finally, we will explore scale economics and the Technology Readiness Level, and discuss the technical locks that still need to be lifted to make this process economically viable.

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