CO_2 storage and H_2 production from olivine bearing mine tailings

KANCHANA KULARATNE[1], ISABELLE MARTINEZ[1*] AND OLIVIER SISSMANN[2]

[1]IPGP, Paris, FRANCE; [2]IFP energies nouvelles, FRANCE
(*martinez@ipgp.fr)

We conducted hydrothermal experiments to study the potential of olivine bearing mine tailings (from New Caledonia), to simultaneously store carbon dioxide (CO_2) and produce hydrogen (H_2) at hydrothermal conditions. Powdered mine tailings were reacted with CO_2 saturated pure water at 473-573 K and 15-30 MPa, in batch reactors. Gas and liquid were frequently sampled from the on-going experiment. After 25 days of reaction, CO_2 was sequestered in the form of Fe-bearing magnesite, (Mg, Fe)CO_3 in all the experiments. Maximum carbonation yield was achieved at 523 K and 30 MPa, which was 53.8 wt.% of run product, equivalent to the trapping of 320.5 g of CO_2 per kg of mine tailings. H_2 was produced via the redox reaction between Fe^{2+} in olivine and water. The highest quantity of H_2 was produced at 573 K and 30 MPa which was 0.57 g of H_2 per kg of mine tailings. Our results suggest that the intermediate temperatures between 523-540 K at 30 MPa are favorable for simultaneous ex-situ CO_2 mineral sequestration and hydrogen production from New Caledonian mine tailings. The quantities of CO_2 trapped and hydrogen produced lie within the same order of magnitudes compared to previous studies performed at nearly similar experimental conditions. Locally, this study suggests the H_2 produced by this method could cover a large part of the island's electricity consumption. More globally, it has implications for cost effective disposal of industrial CO_2 emissions and production of H_2 (clean energy) in large scale, if the temperature necessary for the reaction is supplied by the heat emitted by the industry itself, for example, in this case the high temperatures melting of ore.