Carbon Capture and Storage (CCS) – the potential for mineral carbonation in the Swedish onshore bedrock

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Keywords: CO_2, BECCS, mineral carbonation, geological storage, Sweden

The paper/pulp industry is responsible for 5 % of the world's total industrial energy consumption, and 2 % of the direct CO_2 emissions (Trudeau et al. 2011). Companies are now looking to offset their carbon footprint by reducing their use of fossil fuels and implementing the BECCS technique, bio-energy with carbon capture and storage. In the recently started BECCS project INSURANCE (Utilization of industrial residues for an efficient geological BECCS), the aim is to advance the CO_2 capturing technique through the use of enzymes and the industry's own waste streams and to investigate the potential for onshore geological storage for BECCS in Sweden. The project is a collaboration between the research groups biochemical process engineering and ore geology which will deal respectively with the CO_2 capture and targeting geologically suitable storage sites, together with the packaging company BillerudKorsnäs.

As a case study, the BillerudKorsnäs-owned Karlsborg paper/pulp plant, outside Kalix in northern Sweden will be used. The plant itself, is located on metavolcanic rocks of mainly basaltic origin mimicking the geological conditions of the Icelandic CarbFix project. These Swedish rocks are however compared to the Icelandic equivalents metamorphosed and deformed. In addition to this case study, there will also be a national perspective and investigation of mafic and ultramafic rocks around other existing major paper/pulp plants throughout Sweden for potential implementation of BECCS.

The first step of the project will be to investigate relevant factors such as minerology, textures, permeability and porosity. Subsequently, aqueous carbonation experiments will be carried out using the enzyme-captured CO_2 coupled to geologically favorable sites in close proximity to CO_2-emitting industry plants. The rock samples will be tested in an experimental reactor with the reactive medium simulating geologically realistic pressure/temperature conditions for CO_2 injection sites in the bedrock, to quantify the rates of how efficiently the silicate minerals can liberate divalent metal cations and produce carbonates. Basaltic rocks in Sweden and across many places around the world are metamorphosed and deformed and will thus behave differently to CO_2 sequestration compared to younger, more porous and highly reactive basaltic formations that previously have been studied for probable CCS projects (Matter et al. 2011; Marieni & Oelkers 2018). In this project, the overal aim is to improve the capturing technique and the methodology for evaluating the potential for CO_2 sequestration through mineral carbonation in metamorphosed and altered basaltic rock formations.

References

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