

Abstract

Long term geological storage of CO₂ is currently considered a most attractive option in the reduction of greenhouse gas emissions while continuing to utilize fossil fuels for energy production. Mineral carbonation is a long term storage option where CO₂ binds with geologic material (certain rocks minerals) to form stable environmentally benign carbonate minerals (carbonation). Rocks containing the elements calcium (Ca) and or magnesium (Mg) bound in silicate minerals are considered feasible for the process of mineral carbonation. In this study a two phase assessment of the potential for mineral carbonation as a means of CO₂ sequestration in South Africa is investigated. The desktop study investigates suitable locations of ultramafic or silicate bearing rocks in South Africa, for the purpose of mineral carbonation. Potential starting materials and reaction routes are addressed, as well as the slow kinetics of the solid –fluid mineral reaction rates. Current global projects are examined, their applicability in the South African context assessed. The investigation, though conceptual, is hoped to add value to South Africa's carbon emission mitigation strategy.

The experimental study compares the data resulting from the generation of CO₂ adsorption isotherms of a basalt and shale, to those generated from a coal and ash under similar experimental conditions. As adsorption isotherms provide information pertaining to the uptake of CO₂ by a material, and not retention, a second aim of the study attempts to determine the effect of supercritical CO₂ on mineral composition of these rocks, over a period of thirty days or so. This period of time may be insufficient for mineral carbonation to have a detectable effect; longer term samples, are anticipated in future research projects. It is hoped that this research will contribute to the advancement of mineral carbonation processes, especially in South Africa, if not globally.