Natural CO_2 Generation, Entrapment and Water-Rock Interaction of the Otway Basin CO_2 Accumulations, Australia: Evidence for Optimizing Site Selection for CO_2 Geological Storage

Watson, Maxwell N.[1], Peter R. Tingate[1], Chris Boreham[2], Catherine M. Gibson-Poole[1] (1) CRC for Greenhouse Gas Technologies (CO_2CRC), South Australia, Australia (2) CRC for Greenhouse Gas Technologies (CO_2CRC), Canberra, ACT

Natural accumulations of CO_2 offer an excellent opportunity to examine CO_2-water-rock interactions that are likely to occur in future CO_2 geological storage sites. The Otway Basin, Australia, is the focus region for the CO_2CRC's natural analogue research. The Otway Basin is a known CO_2 province, with the initial discovery of CO_2 in 1966, and is currently producing CO_2 from the Gambier Embayment, Port Campbell Embayment and Penola Trough. Through carbon (d13CCO_2) and helium (3He/4He) isotopic analyses, a mantle origin has been determined as the predominant CO_2 source in these accumulations, linked to the degassing of Pleistocene to Recent magmas.

Comparative petrological studies from CO_2-rich gas fields and nearby CO_2-free gas fields display locally enhanced CO_2-water-rock interaction. Labile minerals, such as feldspars, chlorite and calcite are commonly altered to kaolinite and quartz. Precipitation of carbonate minerals also occurs, mineralogically trapping the CO_2. Mineralisation is more apparent in greensand lithologies, where higher concentrations of labile minerals allow increased CO_2-water-rock interaction. Fractured seal rock also displays CO_2 interaction, with siderite precipitation healing fractures and filling porosity, enhancing the seal capacity. The degree of reaction, reaction rates and mineralogical storage of CO_2 are dependent on mineral assemblage, concentration of CO_2 in the gas and CO_2-water ratios.

Studying natural CO_2 accumulations can help validate geological storage as an option for CO_2 emission reduction. This research has also determined the optimum reservoir criteria to benefit CO_2 geological storage, including aspects of CO_2 injectivity, containment and interaction within a reservoir system.