CO₂ Geological Storage Assessment of the Gunnedah Basin, NSW, Australia

Lila W. Gurba

Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC)
University of New South Wales, School of Biological, Earth and Environmental Sciences
Sydney, Australia

The Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) recently completed a basin-scale assessment of the Gunnedah-Bowen Basin in New South Wales for its CO₂ geological storage potential and this paper is the outcome of the study. Amongst all the Australian states, New South Wales is the biggest emitter of greenhouse gases, particularly CO₂. As most of that CO₂ is emitted by coal-fired power stations, it is important to examine the opportunities within the State to apply carbon dioxide capture and storage (CCS) as a mitigation option.

The Gunnedah Basin and the New South Wales part of the Bowen Basin have been evaluated against basin-scale suitability criteria relating to either the containment security, CO₂ storage capacity, or economic and technological feasibility. These criteria were further refined in this study to take into account the effect of igneous intrusions, which are widespread in the sedimentary sequences of the Sydney-Gunnedah-Bowen Basins. Igneous intrusions may have locally produced adverse effects on reservoir quality (porosity and permeability), as well as affecting the gas content and composition. Sedimentary basins in which there has been widespread igneous activity, require careful assessment for both hydrocarbon exploration and CO₂ storage potential.

Analysis of the regional geothermal gradients in the basin shows a considerable increase southward from 20-25°C per km in the north, to greater than 50°C per km in the south. The temperature differences associated with this variation will affect CO₂ density distribution and hence storage capacity within the basin.

Vast coal deposits present opportunities for CO₂ storage in the Gunnedah Basin coals. Some of these coal deposits are unattractive for mining due to remoteness, great depth, insufficient thickness, and poor quality. Deep sandstones in the southern Bowen Basin are significant potential reservoirs, and limited volume is also available in the sediments in the main depocentres of the Gunnedah Basin, however, further investigations are required into reservoir quality (porosity, permeability). This study also draws attention to the significant storage opportunities that may exist in basalt formations underlying the sedimentary sequences in the study area.

The Gunnedah Basin, perhaps uniquely, may offer opportunities for CO₂ storage in deep sandstone reservoirs, coal seams and unconventional reservoirs such as basalt formations, in a vertical stratigraphic sequence, providing multiple storage targets. The Gunnedah Basin is geologically unusual because all three potential geologic storage opportunities exist in fairly close proximity to substantial CO₂ sources and in some cases may be accessed from one site. They lie in generally sparsely populated areas, away from coal mining tenure, and national parks.

Coal seams and natural gas accumulations in conventional reservoirs of the Gunnedah Basin may have high CO₂ contents. The presence of naturally occurring CO₂ demonstrates the efficacy of this basin for long-term storage of CO₂. However, it also indicates a decrease in total pore volume of the basin, because some pores are already occupied by CO₂.