# Numerical simulation study on mitigation of the pressure build-up in the geological formation during injection of $CO_2$

*Claudia Fujita[1], Yusuke Hiratsuka[1], Hajime Yamamoto[1], Takahiro Nakajima[2], Ziqiu Xue[2]

1. Taisei Corporation, 2. Research Institute of Innovative Technology for the Earth Kyoto

The injection of supercritical $CO_2$ into the deep underground increases the pore pressure in the geologic formation, first locally around the injection point, later spreads radially throughout the capture formation. The range of pressure increase depends on the injection rate, injectivity and reservoir volume. The increase of pressure in the reservoir may cause several problems, including fault reactivation, changes in the groundwater flow direction, changes in hydrogeological conditions and changes in the neighboring pressure regimes.
We investigated how effective pressure build-up can be reduced by applying pre-injection formation water (brine) production as proposed by Buscheck et al. in 2014 (dual-mode wells), or production of brine in parallel to $CO_2$ injection. Numerical simulations were conducted, using the TOUGH2/ECO2N code, developed at the Lawrence Berkeley National Laboratory (LBNL).
We employed a simple reservoir model based on available data of the large-scale CCS demonstration project at the Tomakomai area in Hokkaido, Japan. The efficiency and influence of two reservoir volumes, and a hypothetical placed production well, on pressure build-up in the storage formation were tested. Two models with different volumes, and an injection rate of 1 Mt/yr were applied and three cases were simulated for each model. The first case only considered injection of $CO_2$ for 100 years without previous production. The second case examined the dual-mode well, which included previous production for 5 years prior $CO_2$ injection for 100 years. The last (third) case considered production of brine while injection of $CO_2$ by using a separate installed production well. Judging from the results, the following conclusion can be drawn: 1) The dual-mode well with short duration of water production (5 years) was not so effective to maintain the reservoir pressure in the large reservoir volume considered here. The method would be better suited for smaller reservoir, otherwise a very long-term production would be necessary. 2) Water production in parallel with injection was very effective in order to maintain the reservoir pressure and to avoid harmful effects on the overlying seal layers and other hydrogeological conditions. The methods can be applied to make CCS technology much more sufficient through increasing the effective capacity of injectable CO2. It may also lead to more opportunities related to site selection. However, it has to be emphasized, that the effectiveness of the production strategies investigated here may highly depend on site conditions. Therefore, the results obtained in this study should be regarded as a preliminary evaluation for the Tomakomai site specifications. Further investigations would be necessary, when more data become available through the site investigation and even operations.

Keywords: Carbon Capture and Storage, pressure build-up, production of formation water

©2017. Japan Geoscience Union. All Right Reserved. 