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CO2-DISSOLVED: coupling of the underground storage of dissolved CO_2 and geothermal energy recovery - Preliminary risk study.

Final Report

BRGM/ RC-65363-FR -FR
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Geoscience for a sustainable Earth
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Study carried out as part of the CO_2 DISSOLVED project funded by the ANR (Agreement ANR -12-SEED-0009-01)

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Synopsis

This report is the deliverable 3.3 of the CO_2 DISSOLVED project funded by ANR (Agreement ANR -12-SEED-0009-01). The objective of the CO_2-DISSOLVED project is to assess the technical-economic feasibility of a novel Carbon Capture and Storage (CCS) concept integrating (1) an innovative post-combustion CO_2 capture and dissolution technology, (2) injection of dissolved CO_2 instead of supercritical CO_2, and (3) combined geothermal heat recovery in the extracted brine via a doublet/surface heat exchanger system.

The objective of this report is to make a synthesis of the main results of the project concerning the management of the risks of the technology. Only some risk management aspects have been considered: establishment of the context, risk identification and risk assessment for two scenarios (considering two different geological layers). Risk scenarios are considered as unexpected events or accidents that could have consequences on sensitive stakes (human health, aquifers, environment…).

During the establishment of the context, a bibliographical review has been done for risks of geothermal exploitation and supercritical CO_2 storage. It appears that the environmental impacts associated with low temperature geothermal systems are rarely a source of significant consequences. For CO_2 storage, experience is limited compared to the expected duration of storage but there is an abundant literature about risks. Although a significant experience and/or literature are available about risk management in the field of geothermal exploitation and in the CCS domain, we conclude that this learning cannot be directly re-used and that new gaps have to be tackled.

A risk identification exercise has been performed for the technology. The method that was used is based on the collective work of an expert panel during a dedicated workshop (method derived from the CCS domain among others). This workshop was based on pluridisciplinary expertise to identify underground risk related to the technology. In this process, each participant was invited to share his view and his knowledge during a constructive and open discussion. The results of the workshop have been synthetized in a set of risk identification diagrams.

Risk assessment has been performed on a typical case study in the Paris Basin. Studies have focused on the possible impacts of dissolution and associated geomechanical consequences. Due to the high velocity of injection, near the injection well the most probable dissolution pattern initiated at pore scale are uniform dissolution and wormhole dissolution. Regarding mechanical impacts of reservoir rock dissolution, models used on a case study show negligible effects of reservoir compaction or cavity collapse due to dissolution on surface subsidence and horizontal surface strain due to high depth of the reservoir. Regarding well integrity and overburden integrity, consequences could be significant and should be evaluated more precisely.

Some recommendations have been performed for the management of the risks of a pilot scale project. Among them, implementing a sound risk management framework based on existing standards and best practices seems necessary to be able to demonstrate to the public and to the authorities that the technology could operate safely. Nevertheless, our knowledge of the risks events is still incomplete. Thus, some areas where further research is needed have been identified including the chemical and thermal impact of dissolved CO_2 in carbonate reservoir (in particular dissolution pattern at reservoir scale), the prediction of the CO_2 plume migration in the reservoir and the fate of CO_2 in a long term perspective. Besides, it seems also necessary to

clarify the legal framework of the CO_2-dissolved technology because it could have several implications in terms of risk management requirements for site selection and permitting.