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Storage of CO_2 at low temperature as liquid or solid gas hydrate -Application to the Biscay deep zone in the French EEZ

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Amongst the various CO_2 geological storage options currently under consideration, the deep saline aquifers (beyond 800-m depth) were considered to present the most interesting storage capacity due to the density of CO_2 in its supercritical state. However, at lower temperature, another form of storage is possible, either in the state of CO_2 hydrates or liquid CO_2 (1, 2). In Alaska, a first demonstrator showed recently the possibility of exchange of CO_2 and CH4 in natural gas hydrates. At higher pressures common in deep-sea sediments, liquid CO_2 can be denser than the overlying seawater and therefore be trapped in the marine sediments (2).

We explored in this work the storage capacity at the Biscay deep zone in the French Exclusive Economic Zone (EEZ). A local bathymetry of the zone (abyssal plain and continental margin) was used to define a potential interesting zone for the CO_2 storage, considering different safety criteria. A sensitivity analysis on the geothermal gradient was carried out using two extreme scenarios (Low and High gradient) based on the available Ocean Drilling Program's data. In both cases, the Negative Buoyancy Zone (NBZ) and the CO_2 Hydrate Formation Zone (HFZ) were calculated using the GERG-2008 Equation of State for liquid CO_2 and the CSMGem code for CO_2 hydrate, respectively. Following this sensitivity analysis, a CO_2 injection depth is proposed and the French "deep offshore" storage capacity is quantitatively evaluated and compared to the "onshore" storage capacity in deep saline aquifers.

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