



## **Simulations for CO<sub>2</sub> injection projects with Compositional Simulator**

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Management of CO<sub>2</sub> storage sites and CO<sub>2</sub> Enhanced Oil Recovery projects is still in its infancy, although decades of experience may exist in few specific basins (e.g. Permian Basin in Texas) restricted to on-shore geological environments. The need for CO<sub>2</sub> emissions reduction at a large scale globally implies that CO<sub>2</sub> injection into the subsurface be undertaken in new environments (offshore and in a greater variety of basin settings). Presently, experience is limited as only a few projects are ongoing over the last 5 years, e.g. Sleipner in the North Sea.

Because of the special properties of CO<sub>2</sub> (or gas mixtures in which it is the dominant component), various phenomena and processes are enhanced in comparison with the behavior of other hydrocarbon gases at the same conditions. This is not only caused by the specific values CO<sub>2</sub> properties exhibit such as density, viscosity, heat capacity, interfacial tension among others, but especially the strongly non-linear variation of these properties with temperature and pressure. Complex processes at different time and spatial scales also arise, e.g. dry-out due to evaporation of water in the near well-bore region due to continued injection or chemical reactions between injected CO<sub>2</sub>, brine and rock as well as present organic matter or hydrocarbons.

It is important to be able to simulate these processes correctly and accurately to obtain an understanding of how and where they impact reservoir and caprock. Various simulation tools exist mostly in the academic community that incorporate the necessary physics and chemistry of these processes. They have advanced process understanding by application to simplified scenarios. Full scale reservoir models are prohibitive in size and computing effort. Compositional simulators for the oil and gas industries could be a robust alternative for full scale models, especially for the operations and early abandonment phases. The compositional simulation package ECLIPSE300 is

being further developed and enhanced with features to address these issues. Selected examples of simulations will be shown for CO<sub>2</sub> injection in several geological scenarios at the full reservoir scale. Injection into a depleted gas field and saline aquifers with a variety of characteristics illustrate the subsurface complexity of such operations and the importance of appropriate numerical tools to support engineering and operational decisions.