Identification of a representative dataset for long-term monitoring at the Weyburn CO_2-injection enhanced oil recovery site, Saskatchewan, Canada

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Abstract

Leakage at geological carbon storage (GCS) sites, driven by increased system pressure and higher CO_2 saturations, represents a key risk to secure containment of injected CO_2. For long-term GCS monitoring, it is critical to determine a level of information needed to minimize leakage risks while keeping costs under control. This study demonstrates a goal-oriented, retrospective design concept called minimum data set requirement (MDR) for Weyburn Midale Project (WMP), a commercial-scale, CO_2-injection enhanced oil recovery (EOR) site in Canada. More than a decade of research at the WMP site has led to an extensive collection of site characterization data, a situation that is unlikely to be true for many other GCS projects around the world. By screening existing data retrospectively, our MDR identification process seeks to establish a level of data needed to define a sufficient reservoir model for guiding post-EOR monitoring, under user-defined performance metrics. Our starting point is an existing history-matched WMP reservoir model and three datasets consisting of logs from hundreds of wells and a seismic survey. An iterative approach is taken to systematically and gradually reduce the level of information used in parameterizing a geological model, from which conditional stochastic realizations of model properties are generated and simplified reservoir models are developed. Results show that the minimum dataset for predicting CO_2 migration is based on the heterogeneity and anisotropy of selected parameters of the field. For WMP, about 80% of the 403 wells can be eliminated without having a detrimental impact on the simulated pressure field.