

HISTORY MATCHING A CO₂ HUFF ‘N’ PUFF EOR PROJECT WITH CMG’S GEM AND CMOST

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ABSTRACT

A CO₂ huff ‘n’ puff (HNP) enhanced oil recovery (EOR) project was carried out in the E. Goetz 1 well located in the Northwest McGregor field of Williams County, North Dakota, USA. The HNP is one of the Plains CO₂ Reduction (PCOR) Partnership Phase II field validation tests where CO₂ was injected into a fractured carbonate reservoir for the dual purpose of CO₂ EOR and CO₂ storage. Because of the high level of uncertainty in many of the reservoir properties, part of this research explored methods of uncertainty identification and sensitivity analysis of geological properties by history-matching production and injection data with time lapse seismic and wireline technologies.

Initially, homogeneous cases were produced for the purpose of determining approximate fracture and matrix properties. This method employed experimental design and sensitivity analysis using Computer Modeling Group’s GEM and CMOST software packages to determine the most probable sets of reservoir properties. Based on the results of the homogeneous model analysis, heterogeneous models were developed using geostatistical methods to generate different stochastic realizations of heterogeneous geological and fluid properties for history matching. As with the homogeneous cases, the heterogeneous models were fed into an uncertainty and sensitivity analysis to determine the heterogeneous fracture and matrix property “heavy hitters,” reducing the number of simulation factors that most affect injectivity and production while reducing history-matching simulation runs. In the end, a small number of heterogeneous cases were generated, which can be used to predict the incremental oil recovery potential and long-term CO₂ fate.