APPLICATION OF THE U.S. DEPARTMENT OF ENERGY CO_2 STORAGE RESOURCE ESTIMATION METHODOLOGY ON THE DEADWOOD FORMATION, WILLISTON BASIN

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ABSTRACT

As part of ongoing regional characterization activities, the Plains CO_2 Reduction Partnership estimated the saline formation CO_2 storage resource for the Deadwood Formation in the Williston Basin. The Cambrian/Ordovician Deadwood Formation, an unconformable rock layer created by marine and shallow marine transgressions and regressions, represents the basal unit of the Williston Basin. The basin covers several thousand square miles across parts of North Dakota, South Dakota, Montana, Wyoming, and the Canadian provinces of Manitoba and Saskatchewan.

The storage resource estimate was based on the volumetric approach described in the 2010 Carbon Sequestration Atlas of the United States and Canada, published by the U.S. Department of Energy (DOE). DOE methodology includes storage efficiency factors, based on geologic and displacement terms, which gauge the fraction of accessible pore volume that will be occupied by the injected CO_2. In this study, specific geologic terms for area, thickness, and porosity were derived for the Deadwood Formation, allowing for a modification and thus more precise application of the DOE approach.

Batch petrophysics across approximately 40 wells were calibrated to a single well in which multimineral petrophysics were performed. The batch petrophysics model was upscaled using a single arithmetic average across the Deadwood Formation and again in specific zones after cutoffs (shale volume greater than 30% and bulk density greater than 2.68 g/cm^3) had been applied in the Deadwood. Modeling algorithms, including two dimensional sequential Gaussian simulation using a novel dynamic azimuth anisotropic workflow and simple kriging, were used to derive final effective pore volume across the formation.

The study outlines the steps taken to utilize available geologic data to generate the values needed for a more precise application of DOE methodology for the calculation of storage resource estimates in saline formations. Further, this study compares the results of simply applying the CO_2 storage coefficients published in the DOE methodology, with modified CO_2 storage coefficients that take into consideration the formation-specific geology. By applying this type of workflow, the resulting CO_2 storage resource estimates will have a narrower range of uncertainty, giving decision makers a more accurate picture of the formation's CO_2 storage potential.