Subsurface Core and Analogous Outcrop Characterization of the Muddy/Newcastle Formation for the Bell Creek Oil Field, Powder River County, Montana

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ABSTRACT

The Plains CO_2 Reduction Partnership led by the Energy & Environmental Research Center conducted several field trips to a Cretaceous Muddy (Newcastle) Formation outcrop in Wyoming, which is analogous to the nearby Bell Creek oil field reservoir. Uplift during Tertiary time exposed the Muddy rocks while simultaneously burying the interior Powder River Basin and Muddy reservoir at Bell Creek to a depth of approximately 4500 feet. Ongoing work to prepare for a carbon dioxide enhanced oil recovery project includes characterizing 61 subsurface cores, analyzing whole core and sidewall plugs collected from an observation well, and exploring additional miles of analogous outcrop.

Although numerous wells and core are available in the field, many cores had poor recovery thus reducing the availability to interpret vertical and horizontal variations in facies and internal structure. Because of the reduced number of core, there are subtleties in the 3-D geologic model framework that occur at a finer resolution than the well control. Outcrop examination provides a source of extensive geologic data in the X, Y, and Z directions. This assists in gaining an understanding of regional structure, facies, and heterogeneities that can be correlated back to core and the 3-D geologic models.

The investigation has shown good sedimentological correlation between outcrop and subsurface core. Seven facies have been described on the subsurface core, and six of the seven facies are seen in the outcrop. The separate facies share similar characteristics and allow further lab testing to take place on analogous outcrop rock when sufficient subsurface core is unavailable. Thus describing and sampling the outcrop has provided a valuable visualization tool when the nature of reservoir rocks in the oil field is observed. Data collected from the outcrop provide insight for major variogram ranges, porosity to permeability transforms, geomechanical variables, and flow zones and barriers and help minimize uncertainty while developing the associated 3-D geologic models.