Identification and Prediction of High-Abundance Chert in the Uteland Butte Member of the Green River Formation and its Impact on Drilling Operations

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Abstract

The ability to predict where chert will be encountered is essential to ensuring a successful drilling campaign. Encountering significant quantities of chert during horizontal drilling has a negative effect on the life of the drill bit and can result in more frequent, and expensive, bit trips. In an effort to be more predictive, outcrop, core, and borehole logs for the Uteland Butte Member of the Eocene Green River Formation have been studied with a focus on identifying where chert is concentrated, and what sedimentological characteristics those intervals have. The Uteland Butte Member is a prolific unconventional lacustrine reservoir in the lowermost part of the Green River Formation, which was deposited in the Uinta Basin, Utah. The member is typically divided into four benches termed A, B, C, and D, and wells in the basin target either the C or D bench. In a recent drilling campaign, most of the C bench wells encountered chert in large quantities (as high as 50%). The high percentage of chert causes significant drill bit damage and an associated decline in rate of penetration. This low rate of penetration during drilling operations resulted in frequent bit trips and, therefore, longer total drilling time. The combination of geosteering interpretations, mudlogs, and XRF data enabled the identification of high-abundance chert intervals at bed-scale. These data show that high-abundance chert is concentrated within a specific dolomite bed near the middle of the C bench, commonly called porosity zone 1 (or PZ-1). This same high-abundance chert zone was observed in several cores in the vicinity indicating that high chert concentrations are a regional feature. Core observations revealed that this zone is associated with an equally regional subaerial exposure surface consisting of brecciated dolomite and rooting. The close association of chert with the exposure surface, and the lack of chert in similar dolomites that have no signs of exposure, suggests that chert formed during exposure, or in beds altered by exposure. Analogous chert beds were also observed in several outcrop localities along the southwest and southeast rims of the basin. Additionally, thin siliciclastic beds have been identified during horizontal drilling and in vertical borehole logs that are concentrated at or near this same PZ-1 bed. These beds are interpreted as fluvio-deltaic deposits that reached far into the basin as lake levels retracted at the time of the formation of the exposure surface. An analogous unit has been described at the White Faced Butte outcrop area. These studies have enhanced our predictive ability in the area of interest. Future campaigns will account for high-abundance chert in planning and development of our resource. It is expected that bit fatigue will lessen, rate of penetration will remain high, and wells will ultimately be more economic.