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Carbonate Heterogeneity Based on Lithofacies and Petrography of the Jurassic Twin Creek Limestone in Pineview Field, Northern Utah Thrust Belt*

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Abstract

The Middle Jurassic Twin Creek Limestone in the Utah/Wyoming thrust belt has produced over 15 million BO and 93 BCFG. The Twin Creek was deposited in a shallow-water embayment south of the main body of a Middle Jurassic sea. Traps formed on subsidiary closures along major ramp anticlines where the low-porosity Twin Creek is extensively fractured. Hydrocarbons in Twin Creek Limestone reservoirs were generated from subthrust Cretaceous source rocks. Seals, barriers, and baffles for the producing horizons are overlying argillaceous and clastic beds, and non-fractured units within the Twin Creek. Productive members have little to no primary porosity but exhibit secondary porosity in the form of fracturing. Natural and open fractures provide good permeability pathways within these very low porosity rocks.

Analysis of core from Pineview field in the northern Utah part of the thrust belt revealed complex heterogeneity due to a variety of carbonate lithofacies, textures, structures, and diagenesis (fracturing and stylolitization). Lithofacies include open marine, low- to high-energy middle shelf, microbial mats/tidal flat, marine sabkha, inner shelf microbial lagoon, oolitic shoals, and terrestrial siliciclastics. Carbonate fabrics consist of microbially laminated mudstone, wackestone, packstone, grainstone/rudstone, and thrombolite boundstone with beds of siltstone and shale. These units may contain variable amounts of peloids, hypersaline (broken and “cerebroid”), oolites, oncolites, soft pellets, and skeletal grains (including crinoids, bryozoans, brachiopods, benthic forams, and

bivalves). Sedimentary structures include mud cracks, ripples, cross-beds, burrows, and anhydrite nodules. Mudstone is the dominant fabric for stylolite and fracture development.

Fractures display a complex history of opening, calcite filling, and dissolution. Representative thin sections show nearly parallel, sub-vertical and subhorizontal swarms of calcite- or anhyhdrite-filled microfractures. Visible porosity occurs as isolated dissolution pores and partially open microfractures. Both bed-parallel and bed-normal stylolites are common. Replacement dolomite, microporosity, pyrite replacement, and late calcite along fractures or stylolites are common within productive (perforated) intervals of the Twin Creek Limestone.

Outcrop analogs for Twin Creek reservoirs display closely spaced rhombic and rectilinear fracture patterns developed on bedding planes and within dense, homogeneous non-porous (in terms of primary porosity) limestone beds. Thin-bedded siltstone within various members, also observed in outcrop, creates additional reservoir heterogeneity.

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