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Subsurface Analysis of Tectonics and Sedimentation, Lower Cretaceous Strata, East-Central Powder River Basin, Wyoming

Recurrent movement of basement fault blocks in the east-central Powder River Basin has controlled the distribution of porous and permeable reservoir facies within Lower Cretaceous strata. Subsurface isopach data for Lower Cretaceous time-stratigraphic intervals show repetitive thickness variations for both marine (Skull Creek and Mowry shales) and nonmarine (Inyan Kara and Newcastle/Muddy sandstones) units. Thickness patterns seem to be controlled by recurrent Early Cretaceous structural movement. Paleostructures varying in width from 2 to 10 mi (3.3 to 16.6 km) and in length from 10 to 30 mi (16.6 to 50 km) trend northeast, northwest and north, and include segments of the Black Hills and Fanny Peak monoclines, which bound the west flank of the Black Hills uplift. Early Cretaceous paleostructures seem to control the distribution of Newcastle valleys which are incised into the underlying Skull Creek Shale and drain southwest and northwest (corresponding to the Clareton, Hilight, Osage, Fiddler Creek and Rozet Fields). Valley-fill deposits in Newcastle Formation cores and outcrop show abrupt facies and thickness changes which coincide with evidence of structural control (e.g., drape folds, faults, sandstone dikes, geomorphic lineaments and increased igneous activity). A depositional model, incorporating tectonic and sea-level adjustments, illustrates that Newcastle channel incisement and valley fill are generally restricted to topographic and structural low (graben) areas. This model has been confirmed by detailed analysis of seismic data. Subsurface analysis of tectonic influence on sedimentation aids in petroleum exploration by helping to predict facies distribution and fluid flow.

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