

ISOLATED, TOP-TRUNCATED, WAVE-DOMINATED LOWSTAND DELTA DEPOSITS AND THE POTENTIAL FOR FUTURE HYDROCARBON EXPLORATION WITHIN THE FRONTIER FORMATION, NORTHEAST BIGHORN BASIN, WYOMING

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A detailed sedimentologic and stratigraphic analysis of the 100-175 m thick Upper Cretaceous (Cenomanian-Turonian) Frontier Formation was conducted over ~ 30 km of depositional dip-oriented surface exposure in the northeast Bighorn Basin, Wyoming. The study focused on the characterization of several laterally restricted, north-south-elongate, sandstone bodies of varying thickness, encased in open marine claystones and siltstones within the Frontier Formation. Observed sedimentologic and ichnologic characteristics form the basis for an interpretation of formative depositional environment. Hummocky cross stratification, laterally extensive pebble lags, trough cross-bedding, low-angle to-flat stratification, and synaeresis cracks are common internal sedimentary features. Low-diversity trace fossil assemblages are typical, with only four frequently recurring ichnotaxa. Paleocurrent data, as well as gently dipping clinoform sets indicate southward sediment dispersal. The physical and biogenic sedimentary structures are interpreted to represent a brackish to-fresh-water-influenced, wave-dominated delta, with sediment reworking during intervening transgressions. Several stratal cycles occur in the Frontier Formation (Peay Member), consisting of basal prodelta sediments (claystones and siltstones) coarsening up to proximal delta front to river mouth sandstones and capped by pebble lags. Such bodies are top-truncated, lacking delta platform facies.

Overall, these characteristics are interpreted to represent possible lowstand deposition. The lower portion of the Peay Member also preserves downdip-descending and offlapping sandstone lenses, potentially evidence for falling stage systems tract deposition beneath the main lowstand delta. These laterally restricted, top-truncated, low accommodation sandstone bodies encased in low-permeability marine sediments create probable stratigraphic traps, increasing the potential for hydrocarbon reservoirs and future exploration of the Frontier Formation.