# Seismic Expression Of Eolian Sandstone "Build-And-Fill" Deposition Stimulates The Search For New Reserves In The Minnelusa Oil Play, Powder River Basin, Wyoming

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## ABSTRACT

The Minnelusa eolian sandstone oil play in the Powder River Basin, Wyoming (Figure 1) is a mature play which has produced over 500 MMBO. The depositional sequence of alternating porous eolian sandstones and intervening evaporites, dolomites, and carbonates provides a strong acoustic impedance contrast that allows porous sandstones to be readily mappable (Figure 2). Minnelusa hydrocarbon traps are primarily stratigraphic. Early seismic exploration for Minnelusa fields relied on identification of high amplitude negative impedance integrated with existing well control. In this early stage of exploration many high amplitude anomalies were drilled based upon 2D seismic data often without the benefit of a clear understanding of the regional and sub-regional sandstone depositional trends. The small footprint (1-3 mi2) of many early 3D seismic surveys focused on imaging the distribution of the productive or prospective sand body. However, the small 3D survey size did not allow an adequate aperture to place the targeted sand in context with adjacent Minnelusa eolian sandstones or the erosional trapping facies. 3D seismic surveys targeting Minnelusa oil accumulations have grown larger in size, and these larger surveys facilitate a more robust mapping of the potential eolian reservoirs and trapping configuration. Yet, for a 3D survey that is located in an area of sparse well control, a keen understanding of the Minnelusa depositional seismic response greatly improves the chance of economic success. Fryberger & Hern (2014) proposed the terminology "build-and-fill" to describe a geometric approach to the analysis of global eolian hydrocarbon reservoirs. Minnelusa eolian sandstone deposition may be characterized by this build-and-fill model whereby younger dune complexes are often deposited on the flanks of the underlying sandstones (Figure 3). Seismic data may image these offset dune complexes depending upon formation thickness and seismic frequency spectrum bandwidth (Figure 4.) In order to seismically detect lateral changes that reflect stacked eolian sandstones of differing ages, seismic acquisition and processing must be optimized to provide a broad bandwidth seismic dataset. Detecting lateral formation changes with broadband data is a key to properly identifying productive and potentially productive sandstones. Integrating a build-and-fill geologic model into the seismic interpretation (Figure 5) not only (1) reduces the risk of drilling an unproductive dune complex, but (2) provides opportunities for new discoveries in adjacent eolian sandstones, whether they be older or younger.