Sedimentology of the Lower Cretaceous Sparky Formation, Marsden South Sparky Pool, Lloydminster Area

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Abstract
An integrated geological and geophysical analysis of has been carried out on the marginal-marine deposits of the Sparky Formation in the Lloydminster area of Saskatchewan. These deposits form the primary reservoir in the Marsden South Sparky Pool and comprise multiple stacked, low-energy progradational shoreline sand units and compound incised valley fill (IVF) deposits. Reservoir facies are capped by late Sparky and Waseca-aged non-marine (crevasse splay, channel fill, coal swamp) deposits that form a vertical seal. Locally, these younger channels, partially erode reservoir sand units and, effectively, compartmentalize the pool. However, they also create a stratigraphic trap along the northern and eastern edge of Marsden.

Progradational shoreline sands are regionally deposited over Marsden but are best preserved in the SE portion where they form the primary reservoir. Three upward-cleaning para sequences (<1-8m thick) bounded by 1-2m thick flooding surfaces were deposited. Flooding surfaces form vertical flow barriers and prevent hydraulic communication between successive progradational sequences. Sand quality, as indicated by net:gross and permeability, improves stratigraphically upwards. Porosity range is 21-33% and permeability varies between 200-800 mD. IVF deposits comprise 2 distinct reservoir facies: (1) shelly-sand, deposited in a back-barrier and/or tidal inlet; and, (2) sandy inclined heterolithic stratification (IHS), deposited by tidally-influenced meandering channels. Shelly-sand deposits occur only locally in the west and northwest portion of the pool. These deposits are characterized by blocky sand with articulated and fragmented calcite-cemented bivalve and gastropod shells interstratified with thin (mm to cm-scale) silt layers. Porosity and permeability in this facies is highly variable, ranging from 12-34% and 50-1900 mD, respectively. IHS deposits are the dominant and best quality reservoir facies in Marsden. The IHS sands are blocky, fine- to medium-grained, well-sorted, dune cross stratified and contain rare mm- to cm-thick mud beds. Porosity averages between 30-35% and permeability averages around 3500-3700 mD.