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Structural and Stratigraphic Traps in Kuparuk Formation Reservoirs: Examples from Milne Point, Borealis and Aurora Fields, North Slope, Alaska

The Lower Cretaceous Kuparuk reservoir is a prolific oil producer on the North Slope of Alaska, having produced a total of over 2 billion barrels from several different fields. Kuparuk reservoirs present extremely challenging development problems due to the complex interaction of lithology, unconformities and faults. The Kuparuk formation is a coarsening upward sequence of shallow marine sandstones and mudstones deposited on the flanks of the Barrow Arch during an early phase of Canada Basin rifting. The upper and lower Kuparuk are separated by a major regional unconformity, which may act as a seal to the lower Kuparuk. The upper Kuparuk, also capped by a regional down-cutting unconformity, is vertically sealed by shale units. The Milne Point, Borealis and Aurora Kuparuk accumulations are structurally controlled by a series of doubly plunging faulted anticlines. Two major fault trends are noted in these fields, an Ellesmerian aged basement involved NW-SE trending system that was active at the time of Kuparuk deposition, and a N-S system that post-date Kuparuk deposition. The N-S faults appear to have reactivated some the NW trending faults as transfer faults. The intersection of the two fault sets has resulted in a roughly orthogonal shaped series of compartments. Production waterflood conformance data, fault gouge modeling, and Allen plane diagrams show many of the faults bounding the compartments to be sealing, but may contain significant leak points. Lessons learned from trapping relationships in mature Kuparuk reservoir fields such as the Milne Point and Kuparuk River Fields are being applied to new Kuparuk developments such as Aurora and Borealis.