

Reservoir Potential of Tertiary and Mesozoic Sandstones, Cook Inlet, Alaska

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The Cook Inlet province of southern Alaska is a forearc basin resulting from subduction of the Pacific plate under continental North America. The basin is filled with up to 25,000 feet of Tertiary nonmarine detritus and 30,000 feet of Mesozoic marine and nonmarine deposits. Sediments are sourced from a mixed provenance consisting of a magmatic arc complex to the northwest, sedimentary-metasedimentary accretionary complex to the southeast and through going axial-fluvial system originating to the northeast.

Tertiary sandstones consist of fine-grained to conglomeratic, poorly- to moderately-sorted litharenites, feldspathic litharenites and sublitharenites. They have a diverse mineralogy that is controlled by provenance. The Sterling and West Foreland sandstones are volcanogenic, Tyonek and Hemlock sandstones are quartzo-feldspathic, while Beluga sands consist largely of argillaceous sedimentary and metasedimentary rock fragments. The pore system is mainly primary with core porosities ranging from 5-40% and permeabilities from 0.1 to 5,000 md. Secondary intragranular porosity due to feldspar dissolution is a minor component of the pore network. Pore-filling kaolinite resulting from feldspar alteration is common in feldspathic rocks. Pore-lining mixed-layer clays, the product of VRF alteration and dissolution, are sporadically distributed but have a detrimental effect on permeability where present in even modest amounts. Heulandite and clinoptilolite alterations of volcanic detritus are restricted to the West Foreland sandstones. Due to their young age, moderate burial depth and stable framework mineralogy, the Tertiary sandstones have high potential as conventional hydrocarbon reservoirs.

Mesozoic sandstones consist of very fine- to coarse-grained, poorly- to moderately-sorted feldspathic litharenites, lithic arkoses and arkoses. Their framework mineralogy is also controlled largely by provenance. The Cretaceous Kaguyak sandstones are quartzo-feldspathic, Upper Jurassic Naknek sandstones are feldspathic and quartz-poor, while Middle Jurassic Tuxedni sandstones are volcanogenic. The pore system is typically residual primary with core porosities ranging from 2-15% and permeabilities less than 5 md. Secondary intragranular porosity resulting from dissolution of feldspar and heavy minerals is minor. Laumontite and heulandite, the by-products of plagioclase albitization, are ubiquitous in the Naknek and typically occlude all porosity. Minor fracture porosity is noted in some Naknek sandstones. Authigenic chlorite and mixed-layer clays are extensively developed in Tuxedni sandstones and have a pronounced detrimental effect on reservoir quality. Of all the Mesozoic units, Cretaceous sandstones have the best potential for serving as conventional reservoirs. Jurassic sandstones have low potential as conventional hydrocarbon reservoirs due to their old age, deep burial depth and labile framework mineralogy, but may have potential as unconventional reservoirs.