

Stratigraphy and Sedimentology of the Chinitna Formation, Iniskin-Tuxedni Bays Area, South-Central Alaska-Late Middle Jurassic Depositional Systems and Petroleum Prospectivity in Cook Inlet Forearc Basin

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ABSTRACT

The Chinitna Formation of lower Cook Inlet is a ~700-m-thick marine unit that crops out near the arc-proximal forearc basin margin. Two members of comparable thickness are mapped as Tonnie Siltstone (Bathonian-Callovian) and Paveloff Siltstone (Callovian). Geologic mapping, stratigraphic reconnaissance, and sedimentologic work provide new insights into the Chinitna. A ~70-m-thick channelized conglomerate package at Chisik Island is reportedly associated with Tonnie, but field relations indicate these beds may be younger than Tonnie. Nevertheless, lower Tonnie exposures near Tonnie Peak do host channelized, cross-stratified sandstone. At Iniskin Bay, part of lower Tonnie exhibits thin, sharp-based sandstone intercalated with bioturbated siltstone; hummocky cross-stratified sandstone is also present. Reconnaissance of upper Tonnie reveals a finer-grained interval with local gully-scale channel-forms and mainly fine-grained fills. A generally comparable stratigraphic stacking motif is documented in Paveloff. A ~100-m-thick succession of tabular and channelized sandstone and conglomerate commonly occurs at this member's base, and hummocky cross stratification is also noted. Regionally, overlying finer-grained deposits are observed. Upper Paveloff at Chinitna Bay comprises more than 160 m of bioturbated, very fine-grained sandstone with subordinate coarser, sharp-based sandstone; slump scars and channels with m-scale relief are principally filled with fine-grained detritus. Mountain-scale exposures exhibit even larger channel-forms in upper Paveloff, including a slump-associated feature with ~140 m of stratigraphic relief. Tonnie and Paveloff each record third-order sedimentation cycles. Regressive, lowstand depositional systems with probable delta associations supplied coarse sediment during onset of each cycle. The conglomerate at Chisik Island highlights marked base-level fall (10s of m of incision), probably represents shelf-valley fill, and is tentatively associated with Paveloff rather than Tonnie. Overlying finer-grained successions in both members may reflect waning deltaic influences as near-shore environments were transgressed during rising base level, diminishing sediment supply to prodelta settings in shelfal water depths ranging down to-and perhaps below-storm wave base. Continued transgressions likely terminated direct deltaic inputs into outer shelf settings. The lithologically monotonous, gullied upper parts of each member may record highstand normal regressions-rather than continued transgressions-when muddy clinoforms(?) of delta- to slope-scale relief prograded into the basin during later periods of base-level rise; the strongest evidence for this scenario occurs in Paveloff, where the largest channel-form approaches submarine-canyon-scale. Rock-Eval pyrolysis results from 44 samples (12 from Tonnie, 32 from Paveloff) indicate poor petroleum source potential, with total organic carbon values of 0.14-0.69 weight percent and S2 values of 0.00-0.57 milligrams hydrocarbon per gram of rock. Thermal maturity of the samples ranges from ~0.7% Ro at Oil Bay to 0.85-1.20% Ro at Iniskin Bay based on Rock-Eval Tmax, spore color, and vitrinite reflectance analyses. Sampled Chinitna sandstones are mainly feldspathic and generally have less than 6% porosity and less

than 0.2 millidarcies permeability. Nevertheless, migrated oil is documented in a lower Paveloff outcrop, and viable scenarios exist for Chinitna-hosted oil accumulations.