AAPG Datapages/Search and Discovery Article #90302 ©2017 AAPG Pacific Section Annual Meeting, Anchorage, Alaska, May 21-24, 2017

Preliminary Observations on the Stratigraphy, Tectonics, and Petroleum Geology of Upper Cretaceous Rocks in Lower Cook Inlet, Southern Alaska

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ABSTRACT

Upper Cretaceous rocks in Cook Inlet remain only lightly explored, although limited data suggests the interval has petroleum potential. Encouraging evidence includes oil shows reported from at least two wells (Raven No. 1 and Anchor Point No. 1), and significant oil staining documented in outcrops of Upper Cretaceous strata near Saddle Mountain and in the Kamishak Hills. The latter locality is represented by petroliferous sandstone cobbles and boulders in modern stream alluvium that are confidently interpreted to originate from nearby Upper Cretaceous outcrops. Point counts from two samples of these oil-stained clasts indicate a quartzo-feldspathic composition; reservoir quality analyses yielded porosity values of 10% and 14% and permeability values of 0.01 and 0.2 millidarcies. The porosity is notably higher than nearly all existing data for Jurassic rocks in the region, which likely reflects the lack of significant laumontite cement that typically compromises older Mesozoic sandstones. The residual hydrocarbons are currently being extracted for further geochemical characterization (USGS laboratory in Denver, CO). In order to better understand the Upper Cretaceous stratigraphy, we examined the ~1100m thick upper Campanian to lower Maastrichtian Kaguyak Formation at its type locality at Swikshak Lagoon on the upper Alaska Peninsula. This section is approximately 15 miles south of the Kamishak Hills drainage where we samples the oil-stained clasts. The lower part of the section is dominantly fine-grained with a diverse and abundant trace fossil assemblage, including Helminthopsis, Phycosiphon, Schaubcylindrichnus, Terebellina, Teichichnus, and Thalassinoides. Primary sedimentary structures are rare, likely reflecting deposition below wave base and thorough disruption of lamination by bioturbation. We interpret this part of the unit as offshore transition to shelfal. In contrast, the upper part of the section is dominated by well-bedded, rhythmic alternations of siltstone and very fine- to medium-grained sandstone. Trace fossils and bioturbation are rare, and the totality of sedimentary facies is consistent with deposition via sediment gravity flows, ranging from high density flows to more dilute, turbulent flows. Based on the sedimentary facies, the lack of wave-generated structures, and the dearth of bioturbation, we interpret the upper half of the Kaguyak as comprising deep-water deposits, likely from a base of slope to basin floor setting. The origin of this episode of deepening between the lower and upper part of the Kaguyak is unclear. Forearc basins are dynamically linked to subduction zone processes and phases of substantial basin subsidence are generally ascribed to episodes of tectonic erosion of the upper plate. Integration of our data with published information from the Matanuska Valley and lower Alaska Peninsula indicate that abrupt and significant subsidence is widely recorded along the entire length of the forearc basin during the Late Cretaceous, suggesting a common tectonic driver.