

Triassic Facies Patterns in Northwestern Alaska: Insights into Chukchi Shelf - Hanna Trough Source Rocks and Mesozoic Tectonics

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ABSTRACT

The main oil charge encountered on the Chukchi shelf has been attributed to a facies of the Triassic Shublik Formation that has more detrital components and less carbonate than well-known Shublik strata on Alaska's North Slope. A unique exposure of Triassic rocks at Surprise Creek (SC), near the Chukchi coast, displays characteristics transitional between those of the North Slope Shublik and the Otuk Formation, a distal, deeper water equivalent exposed in the Brooks Range. Petrographic and geochemical studies of the SC section allow us to characterize what may be an outcrop analog for source rocks in the Chukchi shelf. New data from Otuk sections on Cape Lisburne (CL) 100 km to the west provide additional insight into Triassic facies patterns in this area. The base of the ~25 m SC section is the core of an anticline and the top is a Jurassic unconformity, overlain by Oxfordian to Valanginian Kingak Shale (the same succession penetrated by the Klondike well on the Chukchi shelf). The main lithofacies at SC is siliceous to calcareous mudstone that is variously organic-rich (0.3-9.5% TOC; >2% TOC for 22 of 44 samples) and contains sparse to abundant Ladinian and Carnian-Norian flat clams. Subordinate lithologies include phosphatic nodules (typical of the Shublik but rare in the Otuk) and siliceous radiolarite (characteristic of the Otuk but absent from the Shublik). Yellow-weathering bentonite(?) layers (2 to 3 cm thick) are similar to beds seen elsewhere in the Otuk. Concentrations of large [i]Tasmanites[/i] algae resemble ~coeval occurrences in Svalbard, the Barents Shelf, and Siberia. Vitrinite reflectance data from SC strata span the oil window (VR 0.74-1.38%). The SC section has similarities to the Otuk in the area of the giant Red Dog Zn-Pb-Ag deposits ~100 km to the south, but differs in that SC contains phosphate and more abundant megafossils and lacks chert. SC strata also lack the glauconitic siliciclastic facies typical of upper Shublik sections in petroleum exploration wells of the northwest North Slope (e.g., Peard) and Hanna Trough margin (Diamond). Overall, the SC section is most like the 'Shublik equivalent sequence' in the Klondike well (TOC 2-8%), although that section did not contain phosphate. The Otuk section at CL resembles that in the Red Dog area, and both contain organic-rich zones of probable early Norian age (9% TOC at Red Dog). The CL section differs in that it contains a 10-m-thick interval of sandstone interbedded with flat clam wacke-packstone and cherty mudstone. New stratigraphic data indicate that the Otuk sandstone at CL is ~coeval with the Sag River/Karen Creek Sandstone (late Norian?), but it differs in composition, provenance, and setting. CL sandstone yields abundant young (~220-330 Ma) detrital zircon U/Pb ages (Miller et al., 2006), is heterolithic, and formed as turbidites. In contrast, Sag River/Karen Creek sandstone lacks young zircons, is quartz-rich, and formed in a shallow shelf setting. Structural analysis indicates that the Otuk at CL was deposited in a distinct sub-basin that received siliciclastic input from the (present-day) northwest. Detrital zircon U/Pb age spectra from CL resemble those of Triassic sandstones in Chukotka and the northern Sverdrup basin but differ greatly from those of Triassic strata elsewhere in northern Alaska.