Geochemistry, Sedimentology, and Stratigraphy of the Lower Cretaceous Pebble Shale Unit, Northeastern Alaska

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In northern Alaska, a marine mudstone informally named the pebble shale unit (PSU) was deposited in the Lower Cretaceous (Barremian), during the later stages of rifting that led to opening of the Canada Basin. Regionally, the PSU is a seal for the Ellesmerian petroleum system in Alaska (including the supergiant Prudhoe Bay oil field) and has also been proposed as a potential source rock. The PSU is notably equivalent to the Mount Goodenough Formation (Fm) in the Mackenzie Delta area as well as the Kalubik Fm in the subsurface of Alaska's North Slope.

In this study, the PSU is evaluated along the west side of the Canning River and two localities on the north side of the Sadlerochit Mountains where it overlies the Kemik Sandstone and Lower Cretaceous unconformity. Stratigraphically above the PSU is an organic-rich shale interval often referred to as the highly radioactive zone (HRZ) within the Hue Shale. Detailed measured sections of outcrops were augmented by gamma-ray profiles collected with a portable spectrometer; samples were collected for lithostratigraphy, biostratigraphy, thin section petrography, total organic carbon, Rock-Eval II, vitrinite reflectance, and X-ray Fluorescence.

Facies analysis of the PSU reveals hemipelagites that alternate with fine-grained turbidites(?). Sedimentologically, the PSU along the Canning River is a distal equivalent to the PSU exposed on the north side of the Sadlerochits Mtns. The source-rock potential of the PSU assessed in this study is consistent with previous data indicating that the PSU originally had good source-rock potential; however, because of advanced thermal maturity of the study area, the parameters that correspond to source-rock quality indicate considerable degradation. The contact of the PSU and HRZ was only measured along the Canning River where, other than a slight facies change, the contact can only be confirmed with measurements from a gamma-ray spectrometer in the field. As implied by its name, a primary lithologic characteristic of the PSU is the occurrence of isolated, rounded, and frosted quartz grains as well as pebbles and cobbles floating in very fine-scale bedding (sometimes <1-mm). This out-sized detritus is generally interpreted as ice-rafted material. Silicified glendonites were recently discovered in the PSU, suggesting near freezing temperatures and offering further evidence that this important stratigraphic interval was deposited in a cold water, high-latitude setting.