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Distribution, Richness, Quality, and Thermal Maturity of Source Rock Units on the North Slope of Alaska

Five source rock units on the North Slope are identified, characterized, and mapped to better understand the origin of the hydrocarbon charge in each petroleum system: Kuna-Lisburne, Shublik-Otuk, Kingak-Blankenship, Pebble-GRZ-Torok, and Hue Shale. Data from Rock-Eval, vitrinite reflectance, elemental analysis, and well logs are used to map the present-day organic richness (TOC, wt. %), quality (HI, mg HC/gm TOC), thermal maturity (% Ro), and net thickness. To map these units, we assumed that: a) petroleum source rocks contain ≥ 2 wt. % organic carbon (TOC); b) immature oil-prone source rocks have hydrogen indices (HI) > 300 ; c) the top and bottom of the petroleum (oil plus gas) window occur at vitrinite reflectance values of 0.6 and 1.0% Ro, respectively; and d) net source rock thickness is calculated using gross thickness and ≥ 2 wt. % organic carbon for organic matter.

Rock-Eval data for 322 samples from 37 North Slope wells that penetrate the Shublik Formation were filtered using PI (< 0.10), Tmax (400-600 °C) and TOC ≥ 2 wt. %, which left 183 samples to calculate net thickness. Net source rock thickness ranged from 0 to 272 ft with an average of 77 ft. The TOC ranges from 2 to > 9 wt. %, with a mode of 3 wt. %. The HI for immature source rock (Tmax 400-440 °C) ranges from 100 to 900 mg HC/gm TOC, whereas most of the mature and depleted source rock samples (> 440 °C) have < 200 mg HC/gm TOC. These present-day source rock richness and quality maps are used to determine the same characteristics prior to reaching 0.6% Ro.