

Preliminary Interpretation of Rock-Eval Pyrolysis and Vitrinite Reflectance Results From the Nunivak 1 Well in the Nenana Basin, Central Alaska

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The Nunivak 1 well, located in the Nenana basin of central Alaska about 50 miles southwest of Fairbanks, was directionally drilled in 2009 to a total depth of 11,136 feet (corresponding to a true vertical depth of 11,094 feet). The well was drilled on the steep flank of a prominent gravity low and penetrated a thick sequence of coal-bearing strata that may be mostly or entirely of Tertiary age. Air-dried cuttings from the well were kindly provided by the well operators including Doyon, Limited, and its partners. A total of 23 samples of carbonaceous mudstone and coal from drilled depths of 7,600-10,450 feet were submitted to a commercial laboratory for analysis by Rock-Eval pyrolysis. Six samples from depths of 8,170-10,450 feet were examined for vitrinite reflectance in the laboratories of the U.S. Geological Survey (USGS), Denver, Colorado.

The Rock-Eval pyrolysis and vitrinite reflectance results show that coal and carbonaceous mudstone in the Nunivak 1 well are potential sources of oil and gas and are thermally immature to marginally mature with respect to the oil window. Total organic carbon (TOC) in the samples ranges from 11.55 to 61.65 weight percent and averages about 34.5 weight percent, indicating that these rocks have excellent hydrocarbon source potential. Values of S₂ (range 21.29-145.09, average 80.41) also indicate excellent source potential. The kerogens in nearly all of the samples are intermediate between gas-prone (Type III) and oil-prone (Type II) kerogens, as shown by modified Van Krevelen plots and hydrogen index values (range 184-284, average 233). Vitrinite reflectance values range from 0.46 percent R_o at depths of 8,170-8,200 feet to 0.62 percent R_o at 10,420-10,450 feet. These results suggest that the top of the oil window (vitrinite reflectance equal to 0.6 percent R_o) in the Nenana basin at the location of the Nunivak 1 well is at depths of about 10,400 feet.

From a regional viewpoint, the results from the Nunivak 1 well in the Nenana basin may be useful in evaluating the petroleum resource potential of other petroleum-prospective sedimentary basins in central Alaska, for example the undrilled Yukon Flats and Minchumina basins. For the Yukon Flats basin, the USGS estimated in 2004 that undiscovered oil resources range from zero to almost 600 million barrels (MMBO) with a mean of 173 MMBO and that undiscovered gas resources range from zero to almost 15 trillion cubic feet (TCF) with a mean of about 5.5 TCF. However, the USGS has not conducted assessments of undiscovered oil and gas resources in the Nenana or Minchumina basins.