

**Avak Creek Tundra Lake Discharge**  
**Product and Source Investigation Summary**  
**Torri Huelskoetter, EPA OSC**  
**7/23/24**

The UIC sample taken 6/10/24, results delivered 6/28/24, identified the product as petroleum. The following is what laboratory chemist/PM provided for the interpretation of the product *“It smells like mineral oil or middle distillate; the pattern looks like whatever it is has been weathered, and no alkane peaks are present. So I’d think Diesel, Heating Oil, Kerosene, etc. There isn’t much at all in the early or late ends that would make me think gasoline or oil. The whole pattern is in the middle, and it resembles the middle distillates in the library without the alkane peaks. The smoothing is what makes it seem weathered. It’s a Weathered middle distillate.”*

EPA shared the UIC data with EPA’s Environmental Response Team (ERT) and their analysis of the preliminary analytical results and chromatogram on 6/25/24 was that they could not rule out a refined petroleum hydrocarbon. *“The lighter ends, which are a little more vulnerable to degradation than the heavier ends, are present. Whereas the heavier ends of the spectra are not presented and presumably not there. It could be the co-mingling of crude and refined oil; the color alone doesn’t support the refined petroleum hydrocarbon conclusion.”*

After providing a summary of the scenario to the USGS they provided some background information on nearby seeps. *“The best documented natural oil seeps this far north are the crude oil seeps on Cape Simpson, approximately 38 km (24 mi) south-southeast of the Iko Bay well. Those seeps, near the eastern coast of the Dease Inlet, were investigated back in the 1940s-50s with a number of USGS publications resulting from the investigation. So, considering the relative proximity of “Simpson seeps” to the “new” petroleum occurrence, it certainly is possible that a natural seep has been encountered. Having said that, most of the photos sent by ADEC do not strike me as displaying characteristics of natural oil seeps I have seen or that have been documented in the Alaska literature.”*

During EPA’s site visit, samples of the oil were collected on the tundra and from the edge of the lake as well as sheen that was identified around Iko Bay Well #1. Samples were collected between 07/02/2024 and 07/04/2024. The results from an EPA field screening instrument using Fourier-transform infrared spectroscopy (FTIR) technology categorized the oil samples as a refined product, specifically diesel, however this instrument may have limitations in identifying crude oils in its library as that is proprietary information. The sheen sample was categorized as automatic transmission fluid according to the instrument. The EPA samples were sent to the USCG Marine Safety Lab (MSL) for fingerprinting and sample matching.

The MSL analytical results were received on 7/11/24 and indicated that the sheen at the well was lubricating oil and is not a match to the other oil samples from the tundra and lake. MSL stated that *“It is not possible, based on the analysis conducted, to provide conclusive determination as to whether the spilled oil is a crude seep or a refined product. The moderate to severe biodegradation of the samples is interfering with absolute identification. However, the samples are suitable for comparison purposes.”* EPA requested the chromatograms from MSL and they were received via Fedex on 7/17/24.

The USGS stated that they had samples of, and have done geochemical analyses of, samples from the Simpson seep (provided to them by BLM) and two of the Simpson wells, #27 and #31. Even though those oils are biodegraded, they remain the nearest examples of verified hydrocarbons that have been analyzed with state-of-the-art technology. On 7/15/24 the USGS offered to compare/contrast the EPA sample results to their results from the Simpson seep and wells. EPA sent the chromatograms from MSL to USGS on 7/17/24.

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EPA sent additional photos from their site visit to the USGS for review and based on those photos they suggested that the source is most likely a natural seep. On 7/19/24 the USGS sent additional information based on the geological framework, including the framework between Avak Creek and Cape Simpson and regional seismic data.

- “1. There are two viable petroleum source rocks in the area, the Triassic Shublik Formation and the Cretaceous lower Hue Shale.*
- 2. The thermal maturity (indication of maximum thermal exposure during burial) of those two source rocks is in the "early oil window," meaning that oil was generated locally.*
- 3. Seismic data display south-dipping strata south of the oil occurrence and generally north-dipping strata north of the oil occurrence. That is, the oil occurrence is located above an anticline (arch), which is one of the most common places for oil occurrence.*
- 4. Observation #3 means there is a natural tendency for generated oil to migrate to the north from south of the occurrence and to the south from north of the occurrence, driven by buoyancy.*
- 5. Seismic data also display a fracture system directly beneath the oil occurrence. This fracture system likely provided a conduit for upward migration of oil.*
- 6. The old vintage seismic data does not provide detailed resolution near surface, but we know from the nearly Iko Bay well that the formation at the surface (Nanushuk Formation) is only about 100 ft thick locally, is a good reservoir (porosity and permeability), and is underlain by the Torok Formation, which commonly includes pathways through which oil has migrated throughout the North Slope region.*
- 7. The geological framework of the Avak Creek area is very similar to that of Cape Simpson, where natural crude oil seeps have been known for centuries.*
- 8. The area of the oil occurrence is characterized by permafrost, the base of which occurs at about 1,000 feet. Across the North Slope, crude oil and natural gas can be "trapped" at the base of the impermeable permafrost. However, it is not uncommon for both crude oil and natural gas "seeps" to occur even in areas where the permafrost is much thicker, particularly as permafrost deteriorates with rising temperatures.*

*In summary, all of the geological observations suggest that the Avak Creek area is in a favorable location for the occurrence of natural seeps of crude oil and/or natural gas. These observations do not provide unequivocal evidence that the Avak Creek oil occurrence is a natural seep but, thus far, evidence to the contrary is lacking.”*

The engineer from Alaska Oil and Gas Conservation Commission (AOGCC) who reviewed this well said that even though the abandonment of this well was problematic, they did not suspect the well to be the source. The USGS reviewed the BLM orphaned wells reports and, although the apparent timing of plugging the Iko Bay well and the discovery of the oil occurrence is interesting, it is difficult to connect the two events considering the low gas pressure recorded in the well. It is not likely that pressure would result in such an abrupt "remigration" of oil. The area where the product is occurring is a thermokarst lake with melting ice wedges and subsidence.

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After review of the MSL data by USGS they stated that with the current geochemical data the USGS is unable to make a confident determination as to the source of the hydrocarbons. The prominent UCM in the GCFID fingerprints suggests the Avak Creek samples have experienced significant alteration (e.g., via aerobic biodegradation, anaerobic biodegradation water washing, evaporation, and/or other secondary alteration processes). The hydrocarbon peaks discernible on top of the UCM also have a low response relative and likely consist of multiple overlapping compounds.

USGS further stated *“The GCFID fingerprints do show similar signs of biodegradation to the seeps previously analyzed from the Cape Simpson area. GCMS data on the Simpson seeps show less interference and clearer hydrocarbon fingerprints relative to the Avak samples. However, this may be a function of different instruments and methodologies. The samples also may have been exposed to the surface over different periods of time and/or may have experienced different environmental conditions causing varying degrees hydrocarbon biodegradation.*

*It is likely a naturally occurring crude oil seep, rather than some type of petroleum contamination. This determination is based primarily on its location, what was observed with the geologic and seismic data, and lack of evidence to the contrary at this time.”*

In summary, although several refined product terms such as diesel, mineral oil, transmission fluid, and lube oil etc. have been used during the course of the investigation of this oil occurrence, the totality of circumstantial evidence gathered, combined with the best professional judgement of multiple field experts points to the oil occurrence being a natural seep.