Focusing Petroleum Exploration with Regional Geochemical Surveys*

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Abstract

A regional onshore geochemical exploration survey was carried out over the Yukon Flats and Nenana basins in east-central Alaska. The objectives of the survey were to focus exploration within a 2,100 square mile area and demonstrate the existence of liquid hydrocarbons in these supposed “gas-prone” basins. Lake bottom sediments were chosen as the preferred sample medium for the survey because the lakes are thought to be thermal windows through permafrost, they can be collected rapidly with helicopter support, and their effectiveness for detecting oil and gas fields was demonstrated in a previous study over the Tuk oil and gas fields in the Mackenzie Delta of northern Canada. The lake sediment samples were analyzed for headspace, saturated and unsaturated C1 to C7 hydrocarbons and for traces of crude oil using Synchronous Scanned Fluorescence. The regional lake sediment geochemical survey over parts of the Yukon Flats and Nenana basins was effective in that liquid hydrocarbons were detected and the initial 2,100 square mile survey area was reduced to about 500 square miles of prospective ground based on the location of oil and wet gas microseeps. The location of a subsequent 40 square mile 3D seismic survey was guided by the results of the geochemical survey. Regional lake sediment geochemical exploration surveys are a cost-effective tool for demonstrating the existence of liquid-based petroleum systems in remote untested basins. The surveys also help focus more cost-prohibitive geophysical surveys and drilling.
**Composition of Reservoir Fluids**

**Hydrocarbon Analysis of Lake Bottom Sediments and Interpretation**

Withdrawn into a syringe from the can and injected into a gas chromatograph with a flame ionization detector for the analysis of methane (C\textsubscript{1}), ethane (C\textsubscript{2}), and higher hydrocarbons. Fluorescence for C\textsubscript{6}-C\textsubscript{36} aromatic hydrocarbons (indirect measure of crude oil microseeps).

A 250 cc volume of the lake bottom sediments was placed in a 500 ml can immediately upon removal from the core barrel. Samples were sealed on-site with a canning machine, and a 100 ml volume of fluid was displaced with pure nitrogen injected through a septum in the lid.

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**References**


Beaver Oil and Gas Seep (surface gas chamber)
The objectives of this study were to conduct a regional geochemical survey in the Yukon Flats and Nenana Basins to (1) prove or disprove the existence of migrated liquid hydrocarbons in the basins, and (2) focus more detailed survey efforts within a large 2,100 mile² area. The objectives of the study have been met based on the following points:

- The presence of crude oil and condensate microseeps demonstrates oil generation and migration within both the Yukon Flats and Nenana Basins.

- The clustering of volatile and liquid hydrocarbon microseeps in the basins has helped focus the search for oil in a 400 mile² area from an initial 2,100 mile² area.

- Lake bottom sediments are an effective sample medium for regional, near-surface geochemical exploration for petroleum based on the positive results from the Mackenzie Delta and the Yukon Flats and Nenana Basin survey. Fluorescence and headspace hydrocarbon analysis of the lake sediments are effective methods for the identification of volatile and liquid hydrocarbon anomalies on a regional basis.

- The 400 mile² area of hydrocarbon microseeps should be followed up with more detailed soil and based geochemical surveys and 2D seismic anomalies. A 52 mile 3D seismic survey was carried out at Stevens Village to test the geochemical anomalies based on the outcome of this geoscientific survey.