Using Fluorescence Data in Petroleum Exploration

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ABSTRACT

Fluorescence analysis of shallow samples has enjoyed a long history in geochemical exploration for petroleum on land and offshore. Other than special precautions to prevent contamination, land sample collection can be as simple as using a shovel and plastic bag. Chemical preservation usually is not required. Easy sampling and low-cost analysis with ppb sensitivity are benefits of fluorescence techniques.

However, historical difficulty with interpretation caused some misuse and limited wide application of fluorescence techniques in petroleum exploration. Recent advances in modeling vertical migration of reservoir fluids improved our understanding of the concentration patterns observed in fluorescence data at the surface. Understanding liquid hydrocarbon surface expressions made possible new applications for this valuable exploration technique.

Laboratory fluorescence measurements start with solvent extraction of soil or sediments. Ultraviolet light induced fluorescence of the extract is measured at selected wavelengths. More complete measurements can be made using scanning techniques such as single-scan, synchronous scan, or total (multiple) scan. Single-scan fluorescence methods measure 2–ring and 3–ring petroleum hydrocarbons from crude oil.

Hydrocarbons measured by fluorescence techniques are in the liquid phase of petroleum. While mechanisms and models explain vertical migration of gaseous hydrocarbon, upward migration of liquid hydrocarbons is not as well understood. Clues about the migration mechanism can be gleaned from exploration examples. One case history in the Main Pass area offshore Louisiana illustrated fluorescent hydrocarbon concentrations highest over faults and fractures. These observations support a liquid phase vertical migration mechanism. More important, fluorescence data can map surface expressions of faults and fractures.

Fluorescence spectra of shallow soil samples can be similar to fluorescence spectra of the reservoir oil. A 3–ring/2–ring fluorescence intensity ratio reduces a fluorescence spectrum to a single number and offers a simple way to differentiate oil reservoirs among unique surface signatures. Because the 3–ring/2–ring ratio measures amounts of 'heavier' versus 'lighter' hydrocarbons, shallow-sample fluorescent ratios can be used to estimate reservoir American Petroleum Institute (API) gravity.

Examples from offshore and land illustrate using fluorescence-measured liquid hydrocarbons to complement traditional gas data. Easy to collect samples, low-cost analysis, structural information, and the ability to identify and differentiate oil reservoirs are good reasons to consider using fluorescence data in exploration.

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