Geochemical Exploration Fluorescence Applications in Southern US Basins

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Fluorescent 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 advantages of fluorescence techniques.

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 single-scan, synchronous scan, or total (multiple) scan (Brooks, et al, 1983) techniques. 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 at Navigator Field in West Texas (Cannon, et al, 2001) and another case history in the Main Pass area offshore Louisiana (Belt and Rice, 1996), illustrated fluorescent hydrocarbon concentrations highest over faults and fractures. These observations support a liquid vertical migration mechanism. More importantly, we found that 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 (Hebert, 1988) (Calhoun and Burrows, 1992). 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 from surface signatures. Since the 3-ring/2-ring ratio tends to reflect amounts of "heavier" versus "lighter" hydrocarbons, fluorescent ratios can predict possible reservoir API gravity from surface data (Barwise and Hay, 1996).

Easy to collect samples, low-cost analysis, some structural information, and the ability to identify and differentiate oil reservoirs are compelling reasons for obtaining and using geochemical exploration fluorescence information.

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