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Near Surface Hydrocarbon Migration: Mechanisms and Seepage Rates

The AAPG Hedberg Conference, Near-Surface Hydrocarbon Migration: Mechanisms and Seepage Rates goal was to examine mechanisms responsible for surface geochemical signals and to optimize our understanding of near-surface geochemical data in the evaluation subsurface hydrocarbon generation and entrapment. The research papers presented focused on assessment of natural hydrocarbon seepage with long term surface measurements, seismic identification of leakage-migration pathways, variations in surface geological and biological response to different levels of leakage, computer modeling solute transport of hydrocarbons via groundwater flow, residence time of light hydrocarbons in sediments, comparison of surface and subsurface molecular compositions, gas chimneys and their implications to fractured seals, best methods to collect/analyze surface seepage, and identification of transported-reworked hydrocarbon seepage.

Many seepage mechanisms have been proposed; diffusion, effusion, advection with moving waters, colloidal bubble ascent via microfractures, and continuous gas-phase. The analysis of seep rates, changes in hydrocarbon compositions, and surface seepage patterns presented at the Hedberg conference indicate multiple migration mechanisms are responsible for observed surface geochemical anomalies. Diffusion contributes but does not account for observed rapid movement. Effusion requires hydrocarbons to move as an immiscible fluid through water saturated porous sediments. Advection with moving waters requires significant vertical water movement. The gas bubble ascent or continuous gas-phase flow concepts assumes small colloidal bubbles (microbubbles) move vertically as a continuous, non-wetting phase in water wet rock through a network of microfractures.

Surface geochemistry (seep analysis) will become a more powerful tool with the integrated evaluation of surface geochemical measurements and geophysical migration pathway analysis, and a better understanding of migration mechanisms responsible for observed near-surface geochemical anomalies.