# Finding New Pays in Old Plays: Applications for Surface Geochemical Exploration in Mature Basins

**Dietmar (Deet) Schumacher[1] and Luigi Clavareau[2]**

[1]E&P Field Services, USA,
[2]E&P Field Services, France

## ABSTRACT

High-resolution surface geochemical surveys and research studies document that hydrocarbon microseepage from petroleum accumulations is common and widespread, is predominantly vertical, and is dynamic (responds quickly to changes in reservoir conditions). These characteristics create a suite of applications for surface geochemical surveys that are well suited for mature basins: early delineation of field limits, field development, reservoir characterization, identification of by-passed pay, near-field exploration, and monitoring patterns of hydrocarbon drainage. Combined with other uses of surface geochemistry like high-grading leases, leads, and prospects, these new applications show great promise for better prospect evaluation and risk assessment in mature basins.

Because hydrocarbon microseepage is predominantly vertical, the extent of an anomaly at the surface can approximate the productive limits of the reservoir at depth. The detailed pattern of microseepage over a producing field can also reflect reservoir heterogeneity and distinguish hydrocarbon-charged compartments from drained or uncharged compartments. Additionally, since hydrocarbon microseepage is dynamic, seepage patterns change rapidly in response to production-induced changes. Determining the depth or identity of the reservoir responsible for the surface anomaly is not always possible, but can sometimes be inferred from its geochemical and isotopic composition, from detailed anomaly shape, and from passive electromagnetic data.

Hydrocarbon microseepage anomalies are identified with detailed soil gas, fluorescence, and/or other geochemical analyses. When such surveys are repeated over the life of a field or waterflood project, the changes in seepage patterns can reflect patterns of hydrocarbon drainage. The results of such high-resolution surface geochemical surveys nicely complement geochemical analyses of reservoir fluids and their implications for establishing reservoir continuity and reservoir compartmentalization.

These applications require close sample spacing and are most effective when results are integrated with subsurface data, especially 3-D seismic data. The need for such integration cannot be overemphasized. Seismic data will remain unsurpassed for imaging trap and reservoir geometry, but only detailed soil gas or microbial surveys can reliably image hydrocarbon microseepage from those same reservoirs. This presentation will be illustrated with examples from the USA, South America, the Middle East, and Africa.