

**AAPG International Conference  
Barcelona, Spain  
September 21-24, 2003**

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

Detailed geochemical surveys and research studies document that hydrocarbon micro-seepage from petroleum accumulations is common and widespread, is predominantly vertical, and is dynamic (responds quickly to changes in reservoir conditions). These characteristics create a new suite of applications for surface geochemical surveys: field development, reservoir characterization, and monitoring patterns of hydrocarbon drainage. Combined with more common 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 nearly 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 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. Evidence for such changes are identified with detailed microbial and soil gas surveys. 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.

Applications such as these 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.