When 3-D Seismic Is Not Enough: Improving Success by Integrating Hydrocarbon Microseepage Data with 3-D Seismic Data

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3D seismic data are unsurpassed for imaging trap and reservoir geometry, however, in many geological settings seismic data yield no information about whether a trap is charged with hydrocarbons. Hydrocarbon microseepage data when integrated with 3D seismic data can double exploration success by identifying those traps most likely to be hydrocarbon-charged. This presentation will review the results of integrated 3D seismic and geochemical surveys (1) over pinnacle reefs East Texas, (2) Pennsylvanian channel sandstones in Oklahoma, (3) in the Ft. Worth basin of North Texas, (4) Morrow channel sands in the OK-TX panhandles, (5) over a large, nearly depleted field in Venezuela, and (6) a recent discovery in western Venezuela.

Microseepage data acquired over the Cotton Valley reefs clearly discriminates between hydrocarbon-charged reefs and dry or non-commercial reefs. Gridded hydrocarbon microseepage data over Pennsylvanian channel sandstones in OK and TX distinguished between charged and uncharged reservoirs and/or reservoir compartments. In north Texas, geochemical evaluation of a seismically defined Ordovician Ellenburger structural trap identified a minor seepage anomaly associated with it and an extensive microseepage anomaly over an adjacent structural low. Subsequent drilling yielded a dry hole on the “high” and discovered a new Park Springs Conglomerate (Pennsylvanian) field in the area of the seismic “low.” In Venezuela, survey results identified areas of bypassed pay within the old field, and several new drilling opportunities outside present field boundaries. Lastly, a post-discovery microseepage survey in western Venezuela identified the probable field limits, subsequently documented by further drilling.

Applications such as these require close sample spacing and are most effective when geochemical results are integrated with 3D seismic data. High-resolution microseepage surveys offer a flexible, low-risk and low-cost technology that naturally complements traditional geologic and seismic methods, and can significantly improve exploration success rates.