AAPG Search and Discovery Article #90048 © 2005 AAPG Mid-Continent Section Meeting, September 10-13, 2005, Oklahoma City, Oklahoma

When Seismic is Not Enough: Improving Success by Integrating High-Resolution Surface Geochemical Data with Seismic Data.

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Seismic data are unsurpassed for imaging trap and reservoir geometry, however, in many geological settings seismic data yield little or no information about whether a trap is charged with hydrocarbons. In other settings, the acquisition of seismic data is difficult and extremely costly, and quality of such seismic data is poor due to unfavorable geology or surface conditions. Detailed surface geochemical surveys document that hydrocarbon microseepage from petroleum accumulations is common and widespread, is predominantly vertical, and is dynamic (responds quickly to changes in reservoir conditions).

For this presentation we will review the results of integrated seismic and geochemical surveys (1) over East Texas Cotton Valley pinnacle reefs, (2) in the Ft. Worth basin of North Texas, and (3) from Pennsylvanian channel sandstones in Oklahoma and Texas. Geochemical data acquired over the pinnacle reefs clearly discriminated between hydrocarbon-charged reefs and reefs subsequently shown to be dry or non-commercial. In the Fort Worth basin example, geochemical evaluation of a seismically defined Ordovician Ellenburger structural trap identified a minor microseepage anomaly associated with the Ordovician high and an areally extensive hydrocarbon microseepage anomaly over a nearby structural low. Subsequent drilling found non-commercial oil on the «high» and, more significantly, discovered a new Park Springs Conglomerate (Pennsylvanian) field in the area of the seismic «low.» The channel sandstone surveys in Texas and Oklahoma demonstrate the use of gridded microbial surveys to discriminate between charged and uncharged sandstone reservoirs.

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 geochemical surveys can reliably image hydrocarbon microseepage from those same reservoirs. High-resolution microseepage surveys offer a flexible, environmentally friendly, low-risk and low-cost technology that naturally complements more traditional geologic and seismic methods. Properly integrated with 2-D and 3-D seismic, their use has led to the discovery of new reserves, drilling of fewer dry or marginal wells, and optimization of the number and placement of delineation, development, or secondary wells.