Non-Seismic Detection of Hydrocarbons

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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. In other settings, the quality of seismic data is poor due to unfavorable geology or surface conditions.

The surface manifestations of hydrocarbon seepage and microseepage can take many forms, including (1) anomalous hydrocarbon concentrations in sediments; (2) microbiological anomalies; (3) mineralogic changes such as the formation of calcite, pyrite, uranium, elemental sulfur, and certain magnetic iron oxides and sulfides; (4) bleaching of red beds; (5) clay mineral changes; (6) acoustic anomalies; (7) electrochemical changes; (8) radiation anomalies; and (9) biogeochemical and geobotanical anomalies. These varied expressions of hydrocarbon seepage have led to the development and marketing of an equally diverse number of hydrocarbon detection methods. These include direct and indirect surface chemical methods, magnetic and electrical methods, radioactivity-based methods, and satellite remote sensing methods. Each has its proponents; each claims success; and all compete for the explorationists' attention and dollars. Is it any wonder explorationists are confused, or at least skeptical?

What are the benefits of using geochemical and non-seismic geophysical hydrocarbon detection methods in conjunction with conventional exploration methods? A review of more than 2600 US and International wildcat wells – all drilled after completion of geochemical or non-seismic geophysical hydrocarbon detection surveys – more than 80% of wells drilled on prospects associated with positive hydrocarbon microseepage anomalies resulted in commercial discoveries. In contrast, only 11% of wells drilled on prospects without such anomalies resulted in oil or gas discoveries.

Clearly, the benefits of such hydrocarbon detection surveys are significant. Although these geochemical and non-seismic methods cannot replace conventional exploration methods, they can be a powerful complement to them. The need for such an integrated exploration strategy cannot be overemphasized. This presentation will be illustrated with examples from surface geochemical surveys, aeromagnetics/micromagnetic surveys, passive and active electromagnetic data, and satellite remote sensing data.