Minimizing Exploration Risk: The Impact of Hydrocarbon Detection Surveys for Distinguishing Traps with Hydrocarbons from Uncharged Traps

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Abstract

The application of surface geochemical prospecting methods to oil and gas exploration has resulted in varied success and considerable controversy despite advances in technology and an improved understanding of migration mechanisms. Few people question that hydrocarbons can migrate to the surface in amounts that are detectable, but many remain skeptical of how such information is best integrated into exploration and development programs.

It has been well documented that most oil and gas accumulations leak hydrocarbons, that this leakage (or microseepage) is predominantly vertical, and that this leakage can be detected and mapped using any of several geochemical and non-seismic geophysical methods (Klusman, 1993; Schumacher and Abrams, 1996; Klusman, 2002).

The surface expressions of hydrocarbon 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 both direct and indirect surface geochemical methods, and non-seismic geophysical methods such as magnetic and electrical methods, radioactivity-based methods, and satellite remote sensing methods.

What are the benefits of using geochemical and non-seismic hydrocarbon detection methods in conjunction with conventional exploration methods? A review of more than 2700 US and International wildcat wells – all drilled after completion of hydrocarbon detection surveys – documents that 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 use of such hydrocarbon detection surveys has significant economic benefit. Although these geochemical and non-seismic methods cannot replace conventional exploration methods, they can be a powerful complement to them and add value to such conventional data and methods. The need for such an integrated exploration strategy cannot be overemphasized.

References Cited

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