

## **Non-Seismic Detection of Hydrocarbons: Methods and Exploration Applications**

**Dietmar (Deet) Schumacher**

*E&P Field Services (USA, France, Malaysia)*

### **Abstract**

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 many 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 2700 US and international wildcat wells – all drilled after completion of geochemical or non-seismic geophysical hydrocarbon detection surveys – showed that >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 because they provide evidence of hydrocarbons in the prospect or area of interest. The need for such an integrated exploration strategy cannot be overemphasized. This presentation will be illustrated with examples from satellite remote sensing data, surface geochemical surveys, aeromagnetism/micromagnetic surveys, and passive and active electromagnetic data. These examples will be from both frontier basins and mature basins in North America, South America, Africa, and the Middle East.