Passive Geochemical Survey Effectiveness: from Sample Acquisition through Drilling Result

Alan H. Silliman
L. Gore & Associates, Inc.
asillima@wlgore.com

A broad view of time-integrated surface geochemical data is presented. Samples are collected through the use of selected adsorbents having high affinity for hydrocarbon compounds. Organic compound response is measured at exceedingly low levels (10e-g grams). An exposure period of -20 days enables sufficient equilibration time for heavy hydrocarbon compounds (C15+ fraction) to be detected above background levels. Adsorbent behavior is discussed in the context of experimental data for toluene uptake. Temperature and soil moisture are potential mitigating factors to be considered. Temperature effects are not as significant to the application, as the method involves in-ground sampling at an approximate depth of 18". Soil moisture may be a significant influence for two reasons: reduction of the soil permeability, and increase of microbial activity leading to hydrocarbon compound degradation.

Advantages of passive sampling include increased compound detection capability, improved data precision compared to instantaneous sampling methods, and broader organic compound data sets (beyond the gaseous range of compounds). These features allow additional utility in geochemical interpretations and robust prospectivity classifications.

Geochemical data processing involves compound .noise-filtering and outlier detection, followed by the development of representative productive and background signatures ("end-members"). Data classification involves the comparison of sample signatures with end-member signatures, using linear discriminant analysis. The comparison is expressed as the probability of match to the productive end-member signature. Examples are shown from work completed in North America (Appalachian Basin), Australia (Cooper Basin), central Asia (Thrace Basin), and the Middle East (Red Sea Basin).

The passive geochemical survey method is a reliable indicator of reservoir hydrocarbons; drilling geochemical anomalies will typically result in hydrocarbon discovery (false positive rate <10%), although economics are not factored in. The method is equally valuable in avoiding negative results. Absence of geochemical anomaly usually means a dry hole, should such a site be drilled (the false negative rate is also -10%, although based on a smaller set of wells). Several examples are offered as evidence of the utility of the passive surface geochemical method.

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