Alan H. Silliman and Melissa Noebes, W. L. Gore & Associates, Inc.

Adsorbent Sample Surface Geochemistry: Mechanics, Application, and Value as Applied to Petroleum Exploration

Adsorbent-based surface geochemical samplers are frequently used to detect a wide range of volatile organic hydrocarbon compounds in soil. Many of these compounds are likely to be of thermogenic in origin, from underlying petroleum reservoirs. Microbuoyancy theory has been proposed as the mechanism for vertical migration of organic compounds, through the stratigraphic column to the surface. This method provides direct detection data for reservoir hydrocarbons, which when integrated with other G&G information may significantly reduce exploration risk. Heavy saturated compounds are detectable in minute amounts (10^{-9} grams). Geochemical samplers are used to collect surface geochemical signatures from exploration areas, and also from available regional petroleum production and dry well sites ("control samples"). Control samples are used to assist the interpretation of survey sample data through a process of "geochemical modeling" (comparing exploration area samples to control sample signatures). The sampler type consists of engineered hydrophobic sorbents contained in a permeable membrane made from expanded polytetrafluoroethylene (ePTFE). The hydrophobic character of the adsorbents is an important feature, to enable the high sensitivity detection of organic compound vapors in at times high relative humidity environments. Samplers are placed in the soil to depths of ~80 cm for a period of usually 2-3 weeks, and collect vertically migrating volatile and semi-volatile organic compounds. Samplers are analyzed for 87 organic compounds, from ethane (C_2) to octadecane (C_{18}), and including pristane (2,6,10,14-tetramethylpentadecane) and phytane (2,6,10,14-tetramethylhexadecane). The analytical list includes several compound classes: aliphatics (normal, branched, cyclic alkanes, alkenes), aromatic and polyaromatic hydrocarbons, aldehydes, terpenes, and miscellaneous compounds (furans). Samplers are analyzed by thermal desorption GC-MS. An example of the application of this technique, and its value in petroleum exploration, is illustrated with project data from a Trenton – Black River play in New York State. The integration of surface geochemistry with 2D seismic proved a successful combination, and led to a gas discovery. This was possible despite a less than optimal survey design, imposed by survey area access considerations. Cumulative project experience indicates that this technique accurately predicts petroleum presence at a rate of ~88%, and has a false negative rate of ~7%.