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Surface detection of reservoir hydrocarbons through vertical migration

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Passive (adsorbent-based) surface geochemical samplers are commonly used to detect a wide range of volatile organic hydrocarbon compounds in soil. Many of these compounds are likely to be thermogenic in origin from underlying petroleum reservoirs. Such compounds are thought to migrate vertically through the stratigraphic column according to microbuoyancy theory. Heavy saturated compounds are detectable in minute amounts (10^{-9} gm).

GORE® Modules were used to collect surface geochemical signatures from a variety of petroleum and dry well sites, during the course of numerous surface geochemical surveys. The module 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, in order to maintain high sensitivity levels for detecting minute quantities of organic compounds. Modules are placed in the soil to depths of ~60 cm for a period of usually 2–3 weeks, and collect vertically migrating volatile and semi-volatile organic compounds.

Exposed modules were analyzed, by thermal desorption GC-MS, for up to 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, olefins), aromatic and polyaromatic hydrocarbons, aldehydes, terpenes, and a few miscellaneous compounds (see Table 1).

Control samples are often collected near producing petroleum and dry well sites when such sites are available. The recorded geochemical signatures from control sites assist the interpretation of survey sample data through a process of "geochemical modeling" (comparing grid samples to control site signatures). The passive surface geochemical method provides direct detection data for reservoir hydrocarbons, which when integrated with other G&G information may significantly reduce exploration risk.

An example of one control site signature is given as an illustration of reservoir hydrocarbon detection at the surface. Other examples are available for discussion, including a discovery through thick anhydrite sequences. The interpretation and use of this form of geochemical data is not without its pitfalls however; proper geochemical modeling is critical for success of the technique. Recent drilling results indicate that the technique correctly predicts petroleum presence at a rate of ~88%, and has a false negative rate of ~7%.

The paper will highlight some recent project successes from both onshore and offshore sites and will reference other projects from the SE Asian region.

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