AAPG Annual Meeting
March 10-13, 2002
Houston, Texas

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Mapping Hydrocarbon Seeps in Varied Terranes with Advanced Spectral Image Processing Techniques

Petroleum exploration began with the search for indications of hydrocarbons at the surface; airborne and space borne sensors with high spatial and spectral resolution and powerful image processing algorithms are bringing our industry full circle.

Seals on hydrocarbon traps range from very efficient to relatively inefficient. Thus many, if not most, hydrocarbon accumulations have some leakage to the surface. The leaking hydrocarbons effect a host of changes on the rocks and soils through which they move. At the surface, subtle differences in mineral composition or vegetation communities manifest these changes.

Using sophisticated spectral processing techniques, it is possible to emphasize some of these subtle differences even using the relatively crude spectral bands of Landsat Thematic Mapper (TM) imagery. In several arid areas, geochemistry, geophysics, and drilling have corroborated the spectral signatures associated with the leaking hydrocarbons. In more humid areas, the task is more difficult. Preliminary findings in parts of East Africa suggest that detecting the effect of hydrocarbon microseepage on vegetation using TM data and robust digital techniques is possible, and sophisticated processing of hyperspectral data in the vicinity of Santa Barbara, California has identified geobotanical spectral anomalies associated with hydrocarbons.

A significant challenge is that the precise geochemical/geobotanical effect that hydrocarbons produce varies from place to place based on hydrocarbon type, rock composition, hydrology, vegetation type, soil characteristics, and climate.