Jeff R. Martin, Mark E. Odegard, GETECH, W. Norman Kent, Kent GeoScience, and Robert G. Hickman, Structural Solutions

An Integrated Analysis of Deeper Hydrocarbon Plays for Eastern Ohio and Western Pennsylvania Using Gravity, Magnetic, Satellite and Geological Data

High gas prices and recent discoveries have focused attention on hydrothermal dolomites of the Trenton-Black River (TBR) of the Appalachian basin. An integrated GIS analysis using gravity, magnetic, topographic and well data, satellite imagery, and surface geology has proven to be a cost-effective method to help find these small and subtle fields. Additionally, our ongoing work has shown that both deeper and shallower horizons in the productive trends have been affected by hydrothermal processes and may be prospective. To make a region prospective, a favorable connection needs to exist between regional aquifers, unconformities and fault zones. This allows adequate flow of hydrothermal fluids necessary to develop reservoir porosity and permeability, and in some cases mature organic material within the TBR. This complete hydrothermal process may affect multiple horizons in its path. Migration of hydrocarbons commonly occurs simultaneously with diagenesis and may follow the same pathways as the hydrothermal fluids. An exploration key is to first identify faults that extended down into the hydrothermal system when it was active. Reactivated basement faults crossing flow paths through the basin, are favorable since they cut all deep aquifers and are likely to have been permeable at multiple times. Fluid flow and diagenesis (hydrothermal dolomites) are focused at the intersections of faults and fracture zones. The amount of diagenesis and the lateral extent of the dolomitization are also dependent on the original porosity and permeability of the target horizon. Since the hydrothermal dolomite reservoirs are developed along fault and fracture zones, part of our approach has been to use topographic, gravity and magnetic data for mapping both fault zones and basement terrain boundaries that localize younger faulting. Satellite imagery can then be used to further refine the probable locations of intersecting fault systems. Use of GIS software allows quick integration of many types of data. This allows the explorationist to more easily high grade areas for more intensive exploration efforts. This integrated method is a cost-effective way of identifying prospective areas and thus focusing exploration dollars for land acquisition, additional seismic or geochemical surveys in the best places. This approach is illustrated by examples taken from the eastern Ohio and western Pennsylvania area.