

SYNERGY AMONGST GEOSCIENCES TO ENHANCE PETROLEUM EXPLORATION EFFICIENCY: CHALLENGES TO ACADEMIA AND INDUSTRY*

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Sedimentary basins are known to be ubiquitous habitats of petroleum. The nuances of sedimentation and vicissitudes of geological history result in very complex distribution of stratigraphic sequences and their structural attitudes in space and time. The fluid distribution in the stratigraphic sequences is also very complex. This makes it difficult for any petroleum exploration method or technique to be equally sensitive and accurate in space and time. No single geological, geochemical or geophysical concept or set of data can help in locating a petroliferous trap in any basin repeatedly, while geological (petrological and paleontological), geochemical, well logging techniques provide primarily a point to point information, the geophysical gravity surveys, electrical surveys, magnetic surveys, remotes sensing surveys and geological surveys provide regional and some three dimensional information of a sedimentary basin. The seismic surveys have the unique capability on a stand alone basis to unravel best an integrated information of a sedimentary volume.

It has always been considered necessary to have specific knowledge of attributes of organic geochemistry of source rocks and knowledge of fluid flow as related to expulsion of petroleum from its source rocks, and reconstruction of distribution of fluid flow fairways during various phases of basin evolutionary history for delineating petroliferous traps. The fluid flow path ways may be along active faults located towards the steeper uprising flank of the generative basin bringing oil and gas from deep mature source rocks to shallower reservoirs or a lateral up dip facies change from fine grained source to coarser grained reservoirs. The porosity and permeability development making a fluid flow fairway in the reservoir rock of any given depositional setting may be along a structural upwarp, related to either basement controlled tectonics or highs generated by syndepositional tectonics. Use of seismic attribute analyses has become an active field of research to identify source rocks and porous and permeable fluid flow pathways. Correlations amongst depositional environments of various lithotypes in source rock unit based on (i) paleontologically derived bathymetry and redox conditions or (i) ratios of various forms of planktonic and benthonic foraminifera, or (ii) paynofacies or (iii) distribution of biomarker molecules or (iv) stable carbon isotope enrichments in organic matter or in authigenic carbonates, or (v) pyritic iron/organic carbon ratios, Fe/Mn ratios or trace element assemblages, and organic matter richness in the given lithotype have also been actively searched for mapping the areal extents of good quality source rocks.