Trends In Oil Exploration

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I am happy to associte myself with your Society of Petroleum Geophysicists. Societies and Associations perform a great service in inculcating a spirit of comradeship, establishing professional ethics, dissemination of knowledge and interaction with other Societies/Associations/ Professional bodies for common objectives of furthering integrated approach to scientific problems.

Geoscientists and engineers of the Oil & Natural Gas Corporation Limited and Oil India Limited (OIL) have done remarkably well over the years in establishing petroleum and natural gas reserves and increasing the total production to over 36 million tons of oil and 22 billion cubic meters of gas (equivalent of 20 million tons of oil) per year. This amounts to a value of Rs. 24,080 crores per year at the rate of 17 dollars per barrel of oil and Rs.34 per dollar. Most of the oil and gas fields in India are geophysical discoveries and the geophysicists can feel proud of their success.

Petroleum exploration and exploitation have been perhaps the most rewarding enterprises since the first oil well was drilled by Drake in 1869. Petroleum industry has been the most critical factor for economic and industrial development throughout the world. It will continue to be so in the developing countries for another 15 to 20 years till alternative energy resources are commercially available.

In India, geophysics for oil exploration was first used in 1923 by Burmah Oil Corporation in the Indus Valley using a torsion balance. Since then geophysics for petroleum exploration has developed by leaps and bounds. The historical perspective shows that petroleum discoveries have followed in cycles directly depending upon new technological advances in geophysics and generation of new ideas about petroleum accumulation.

The recent major advances in Geophysics especially 3-D migration by moving the stacked data to its proper position, greatly clarifies the structural skeleton on which stratigraphy clings and allows more precise definition of reservoirs.

Other new techniques that are being used to extract more detailed structural, stratigraphic, and reservoir information from the seismic data include seismic lithological modelling, reflection amplitudes vs. offset distance analysis, deconvolution, shear- wave exploration, compliment compressional wave exploration, inverse attenuation filters to remove time variance of amplitude from seismic data and vertical seismic profiling

Seismic data is usually required for demarcating reflectors within a sedimentary sequence. Often such studies do not provide detailed information regarding faults and stratigraphic features. In a recent paper, no traditional processing of 3D seismic data has been suggested to demarcate faults and stratigraphic features. The method processes data in a 3D volume or cube of coherent-coefficient within which faults are revealed as numerical supported surfaces.

Next generation of Basin Research has become a field of extreme importance for petroleum exploration. Basins provide the most complete record of geological processes such as rise and fall of Sea level, changes in palaeo-climates, flexure, rates of Sea- floor spreading, oroginies, erosion and total history of its evolution. Basin modelling requires an integration of diverse kind of data including its depositional history, stratigraphy and structural data, chemistry of sediments and fluids, paleo and present thermal conditions. Large computers can now handle sufficient data to simulate basin processes and provide detailed information regarding oil formation, migration and accumulation.

Po-zen Wond in an article on "The Statistical Physics of Sedimentary Rocks" states that "Sedimentary rock makes up much of the

earth's surface and contains two of the most vital fluids for our lives - water and hydrocarbons. Yet physicists have paid little attention to rocks, mainly because we are discouraged by its apparent complexity". Physicists in the recent past have tried to use concepts of statistical physics to gain new insight into the matrix of the sedimentary rocks, and they find that an understanding of the basic physics promises to improve the technologies used in oil exploration and production.

Primary and secondary recovery technologies generally reach about 33% of production of the original oil in place. An additional 3% to 5% could possibly be produced by known tertiary recovery methods. It is thus seen that more than. twice as much oil as currently produced is left in the reservoir and considerable research efforts are needed to take out as much oil as possible out of the left-over quantity. This requires detailed geological analysis of the internal matrix of the reservoir rocks to map and quantify paths of fluid movements. Internal reservoir architecture is a product of sedimentation processes and governs mobile oil recovery efficiency. Application of concepts of statistical physics and detailed geological analysis of internal matrix of reservoir rocks thus becomes a field of study for enhanced oil recovery.

World-wide experience and advances in the exploration and exploitation techniques for oil and natural gas have established that basic studies in geosciences could significantly expand the new discoveries of petroleum and natural gas fields. Fundamental geoscientific studies for improving descriptions of the reservoir combined with the more complete understanding of the fluid flow and interactions of fluid movement in the reservoir are essential for enhanced oil recovery. Geology, geochemistry, hydrogeology, reservoir studies, petroleum engineering and other related field of geosciences together with the understanding of energy drive mechanism in the reservoir are essential for extracting more oil.

A remarkable feature of the ONGC has been to set up a Research and Training Institute within a period of 6 years of its inception. The foresight and vision of the founders of the ONGC and more particularly of Shri K.D.Malaviya had not only given full support to the research and training activities, but also provided full opportunities of interaction with the big oil companies all over the world. As operational activities increased, the applied research directions had not only to keep pace, but march ahead of the operations and we saw the natural diversification and growth of institutions such as Institute of Petroleum Exploration (IPE), Institute of Reservoir Studies (IRS), Institute of Drilling Technology (IDT), Geodata Processing and Interpretation Centre (GEOPIC), Institute of Oil and Gas Production Technology (IOGPT) and Institute of Engineering and Ocean Technology (IEOT).Such a growth in diverse fields of R&D activities under one umbrella of ONGC has remained unparalleled in the history of oil exploration and development in the world. These institutions have provided great strength and support to the operations of the ONGC and have to do so to a greater measure in the years to come.

There has been a growing awareness and importance of integration of different fields of

investigations and bringing together of petroleum geologists, geophysicists, reservoir engineers, production engineers, economists and statisticians to objectively evaluate and assess the potentialities of hydrocarbon discoveries and optimization of exploitation. Production Engineer is often the end user of all the results of geologists and geophysicists and it is therefore necessary that all the information is provided in a way which could be easily understood by the production engineer. Integration of disciplines and discussions among various performers have to be integral part of exploration and production activities. Geostatisticians have developed methods to integrate diverse data types and extract statistical correlations between known data point in order to estimate reservoir properties. Geophysicists should learn about modern geostatistics to provide truly interdisciplinary integration of all the data.

The 21st century is going to see a number of

dramatic changes on a global scale which are bound to have impact on many scientific disciplines. Unlike physics and chemistry, Geology and Geophysics will have to play a dominant role. The four fundamental changes which will have a major impact on Geosciences are (i) Population Growth and Urbanisation; (ii)Pollution and Land Degradation; (iii) Climatic Global Changes, and (iv) Demand for Energy Resources and New Materials. Both the social-oriented and resource-oriented demands on Earth Sciences will have to be accommodated.

With the fast changing economic and industrial environment and growing demands of petroleum and natural gas, the geologists and the geophysicists face great challenges and opportunities. There are vast areas of the country both onland and offshore including deep waters where search for oil has to continue with persevearance and greater committment, with new ideas and new approaches. The known petroliferous basins need to be scanned with latest geophysical tools to look for smaller and smaller deposits. Geophysics needs to be used with latest refinements to provide periodic surveillance of the known oil reservoirs. Enhanced oil recovery technologies must be appropriately used to extract the last drop of oil physically possible.

ONGCL must now become a major international oil company with activities not only in India but around the globe in competition with other oil companies. One hears a lot these days about working in multidisciplinary teams. There is a problem because team members work in different disciplines and speak different languages. Good communication between team members means that each specialist must know his own field and also know something about every other's speciality present in the team.

A good team member has to have four attributes - (i)technical depth in his own discipline, (ii)technical breadth in allied disciplines, (iii)ability to communicate purposefully and (iv)personal sacrifice to become one of the same team. The experience around the world shows that benefits and savings achieved through the use of team work have been impressive including fewer dry holes, better completion of the good ones, more production per well, longer life of each producing well and better and faster return on investment for the oil companies.

A body like **SOCIETY OF PETROLEUM GEOPHYSICISTS** can play a significant role in developing team members with communication skills to play their appropriate role with "petroleum geologists on one hand and reservoir engineers on the other. **I wish the Society every success.**