

India - an Unprecedented Opportunity

Recent exploration successes have fuelled interest in the Indian hydrocarbon industry. With the economy booming and a vibrant, young, well-educated workforce, this may be a good time to investigate the interesting new hydrocarbon opportunities being offered by the Indian government.



The sedimentary basins of India, onland and offshore up to the 200m isobath, have an areal extent of about 1.79 million km². So far, 26 basins have been recognized and they have been divided into four categories based on their degree of prospectivity. In the deep waters beyond the 200m isobath, the sedimentary area has been estimated to be about 1.35 million km². The total thus works out to 3.14 million km² of which about 30% is unexplored.

What is Coal Bed Methane?

Coalbed methane is a clean burning fuel with the same chemical compound as natural gas, but formed under different circumstances. Methane (CH₄) is produced when organic material is turned into coal during burial as both the temperature and the pressure increases. If, during this process, the coal is saturated with water and methane is trapped within the coal, the result is coalbed methane, known as CBM.

The coal is effectively both the source and the reservoir rock, and the gas storage capacity of coal is very high - many times that of conventional reservoirs at low pressures and shallow depths.

The occurrence of CBM has been known for many years, but it was initially treated as a potentially explosive hazard during underground mining. Traditionally, fans were used to extract the gas into the atmosphere, which not only loses an energy source but adds to the 'greenhouse effect' in the atmosphere. In fact, methane from mining is reported to contribute about 9% to total methane emissions.

Extraction of coalbed methane from unmined coalbeds commenced in the early 1900s, when a rancher in Wyoming, USA, drilled a water well into a coalbed and started heating buildings with the produced gas, but it is really only in the last 10 years that it has been recognised as an easily extracted commercial energy source. It is extracted by pumping large volumes of water out of the coal in order to release the water pressure that traps the gas within the coal. Large numbers of wells are needed in order to explore for and produce CBM - possible 10 times as many as required for conventional gas.

Jane Whaley

The Indian hydrocarbon industry is very buoyant at the moment. There have been a number of recent discoveries, including some in the Krishna-Godavari deepwater, off the northeast coast and in the Bay of Bengal, as well as major finds onshore in Rajasthan and other known producing basins.

"These recent successes mean that perceptions in the international oil and gas industry of the hydrocarbon potential of India have changed significantly in recent years," says Bernadette Anderson, Project Manager for the NELP VI and CBM III Licensing Round Promotion at Fugro Robertson.

Virgin Territory

Last month the Directorate General of Hydrocarbons of India (DGH) announced a series of new exploration opportunities, covering a range of risks from untouched deepwater offshore blocks, onshore acreage in established hydrocarbon hot spots, and also 10 blocks for the exploration and production of Coalbed Methane (CBM).

This is the sixth round under the New Exploration Licensing Policy (NELP), and oil and gas companies are invited to bid on a total of 55 blocks; 25 on land, 6 in shallow water and 24 in deepwater, much of the available area being in water depths greater than 3,000 metres. The Coalbed Methane round is the third CBM offer, and the

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government believes that the areas offered have good prospectivity and are considered to hold sizeable reserves.

According to the DGH, one of the most exciting aspects of the NELP VI Round is thought to be the deepwater blocks in the Bay of Bengal. This is completely virgin territory, where there has been no exploration to date, with the exception of a few regional seismic lines. These blocks lie relatively close to recent deepwater discoveries by Cairn Energy and Reliance in the Krishna-Godavari Basin.

Other areas likely to attract interest are in the Assam-Arakan region in the northeast of the country. This is a well-established hydrocarbon province, where reservoirs are found in a wide range of lithologies from fractured granite basement in the Assam shelf to Oligocene to Miocene sandstones in the fold and thrust belt.

Coalbed Methane

India is keen to increase the rate of development of non-conventional hydrocarbons and is therefore offering very good terms in its Coalbed Methane Third Round offering (CBM III). The offered blocks are all in known active coalfields and considered to offer excellent prospectivity.

It is estimated that India holds 162 Tcf (4,536 billion m³) of Coalbed Methane resources in 44 major coal and lignite fields. The resource is under-exploited, with more than half the potential CBM areas essentially unexplored. In the previous CBM rounds a total of 16 blocks were awarded, opening up 7,800 km² for exploration. The production potential in these blocks is estimated to be in the region of 23 MMscmpd.

Exploration in these areas has already yielded significant returns in Central India, where at the Sohagpur Coalfield, for example, in-place gas volumes in excess of 3.5 Tcf (98 billion m³) have been discovered. In Eastern India, further reserves of more than 2.5 Tcf (70 billion m³) have been identified, and commercial production is expected to commence by 2007.

Unique Features

Coalbed Methane is primarily found in intracratonic Permian basins in peninsular India. Smaller deposits are found in Tertiary sediments in nearshore and shelf basins in western, southern and northeastern India.

Indian coalfields have some unique features which suggest that CBM should be a viable proposition, such as thick seams and



Photo: Jane Whaley

Bernadette Anderson is Project Manager for Fugro-Robertson, who is helping promote the NELPVI and CBMIII opportunities with the Indian Government.

highest seam density in the world, with sizeable coal reserves. They exhibit high thermal maturity and permeability with high gas content, and are often found in a low stress regime in a relaxed structural setting. CBM bearing horizons are found at easily extractable depths between 250 and 1,200m.

The Godavari Valley Coalfield is the major coal producing area in South India and is an example of an existing coal operation which the DGH considers has good CBM potential. The Lower Permian Barakar Formation is the main coal-bearing unit, with as many as 10 coal seams, and the down-dip side of the main areas of coal extraction are considered the most prospective for CBM. An area of 386 km² is offered for exploitation under CBM III, and the gas-in-place estimate for the block is 1.05 TCF (29.4 billion m³).

High Level of Interest

"Opportunities for investment in conventional oil and gas exploration and in the coalbed methane sector appear promising, and the level of interest shown backs this up. This really is an unprecedented opportunity to enter one of the fastest growing hydrocarbon industries in the world," concludes Bernadotte Anderson of Fugro-Robertson.

History of Exploration in India

India has several hydrocarbon provinces, and the latest estimates by the Indian authorities of total *in-place* hydrocarbon resources, inclusive of deep waters, are in the region of 205 (32 billion m³) billion barrels oil and oil-equivalent gas. Total oil production in 2004 was over 670,000 bopd and that of gas 320 MMscmd, or 545 barrels of oil equivalent per day.

According to the BP Statistical Review of World Energy 2005, India had *conventional* oil and gas reserves of 5.6 billion barrels (906 million m³) and 32.6 Tcf (920 billion m³), respectively, at the end of 2004.

Hydrocarbons have been produced in India since the 1880s. In fact one of the first producing fields in India, Digboi, discovered in 1889, is still producing today and is reported to be the world's oldest continuously producing oilfield. Pre-independence, oil was only produced from the northeastern and northwestern parts of the country, but after 1948 the national government pushed for further development of the hydrocarbon industry, realising its importance to the economy. Gradually, new onshore hydrocarbon areas were opened up, and production increased from a modest 4,000 bopd in 1950 to more than 160,00 bopd in the early 1970s.

Offshore exploration started in the 1970s and was rewarded with the discovery of the giant Mumbai High Field (Bombay High) in 1974, along with other major oil and gas discoveries in the western offshore. Oil production in India peaked in 1989 at 685,000 bopd, of which Mumbai High accounted for 440,000 bopd.

In 1997 the government of India sought to deregulate the petroleum sector by introducing the New Exploration Licensing Policy (NELP) to encourage exploration. Key features of NELP include minimum expenditure commitment, foreign participation up to 100%, with no mandatory state or NOC participation, a seven year income tax holiday, and generous royalty levels.

By contrast, exploration for Coalbed Methane in India only commenced in 1997 when the government formulated a policy for the extraction of this valuable commodity, offering six areas of interest under the first CBM round in 2001, with similarly attractive terms. Production is expected to commence in the near future.