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Discovery of a Large Startigraphic Trap in a Rift Basin: Case History from Barmer Basin, India

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ABSTRACT

The prolific Barmer Basin emerged as a major hydrocarbon province in India after the giant oil discovery in Mangala in 2004. Intercratonic Tertiary rifting in Paleocene resulted in NNW-SSE oriented rift in the Barmer basin. The Basin was subjected to significant uplift, tilting & erosion during the Himalayan orogeny.

The exploration well DP-1 drilled in the northern part of the basin discovered oil in 2014. The well targeted a large three way faulted strati-structural trap in the Barmer Hill Formation at a shallow depth of 700 m TVDSS. The upper Barmer Hill Formation is composed of interbedded porcellanites and claystone. The lower Barmer Hill Formation is a world class lacustrine source rock which is mature in the adjacent structural lows. The regional top seal is provided by a thick Dharvi Dungar Formation composed of claystones.

An existing well NC-west-1 drilled in 2006 discovered gas in the updip of DP-1. The gas bearing trap was envisaged to be purely structural in nature resulting in a small faulted closure. The Barmer Hill Formation towards the north eastern part of DP field is composed of poorly cemented macroporous sandstones deposited in a deltaic environment. A few wells drilled in the deltaic setting showed a systematic decrease to a complete absence of sandstone thickness
towards DP-1. A conspicuous seismic amplitude anomaly in the Barmer Hill Formation along with rock physics modelling suggested a strong lithology change towards the east of DP field. The deltaic sand thickness decrease and the amplitude anomaly indicated the presence of a pro deltaic facies east of the DP field. The pro deltaic facies was assumed to act as a stratigraphic lateral seal resulting in a much larger closure for the existing gas discovery in the well NC-West-1.

The geological chance of success was estimated at 12 % for the DP-1 well. The presence and effectiveness of the lateral seal provided by the pro delta facies was considered as the major risk.The well DP-1 encountered a thick 166 m reservoir with 98 m net pay on logs in porcellanites. The upper zone tested oil @ 124 bopd form a single porcellanite layer on single frac. Three appraisal wells drilled subsequently have established a much larger stratigraphic accumulation with an areal spread of more than 50 sq. km. Innovative exploration thinking & integration
of subsurface data has lead to successful exploration and appraisal, converting a nearly forgotten small gas discovery into a large oil field.