

Lacustrine Turbidites in Rift Basins: Genesis, Morphology and Petroleum Potential - A Case Study from Barmer Basin

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ABSTRACT

Sedimentary successions of lacustrine rift basins document variations in sediment supply through time, modified by structural controls. Typical continental rift sedimentation commences with fluvial and fluvio-lacustrine regime with progressive deepening of the grabens which have lacustrine turbidite deposits. Internal complexity, difficulties in defining reservoir continuity pose challenges to exploration and exploitation. Barmer Basin, situated in western Rajasthan, NW-SE trending failed continental rift containing mainly Tertiary sediments. Turbidite sands dominate the synrift basin centers during Late Paleocene to Early Eocene in Barmer Hill and Dharvi Dungar Formations. Successful exploration of turbidites has established considerable inplace resource in strati-structural accumulations but challenges on production and optimal recoveries are yet to be resolved. Integrated geological model to explain the depositional architecture and reservoir facies distribution has been attempted using seismic attributes calibrated to cores and wireline logs. Surgical mapping of individual sand packages helped in defining the extent, morphologies and inherent internal geometries. Sourced from the eastern margin, the Vijaya-Vandana turbidites show typical basal sheet sands, confined channel complexes and mounded terminal lobe morphologies in the 3D seismic data. Penetrated in ten wells, the lithological association can broadly be classified into three categories: proximal turbidites along the basin bounding faults dominated by deep water channels, distal turbidites dominated by fan/lobe systems and fluxoturbidites with varying thickness from thin laminations to 5mts thick massive beds. The porosity and permeability of reservoir sands vary widely, from 7% to 23% total porosity and 0.1md to 20md permeability in proximal fan and channels. Individual reservoir zones are highly heterogeneous, compartmentalized and thinly laminated posing serious challenges in reservoir modelling. Three sand rich pulses in Dharvi Dungar Formation have brought in coarser clastics in the deeper basin and which are well demarcated by seismic attributes and well data indicating relatively thin basin margin deltas, slope channels and deeper basin fans.

Thermal maturation modeling suggests Barmer Hill shales are thermally mature in the Vijaya-Vandana graben. Petroleum system analysis of these grabens, charge scenarios and overall potential of the turbidite sequences is detailed in the paper.