Unlocking the West Coast of India: New Stratigraphic Insights from Integrated Seismic and Well Data Study

The west coast of India was fundamentally transformed by the discovery of Mumbai High, with production commencing in 1976 and rapidly establishing the region as the backbone of the country's petroleum output. Additional offshore fields such as Heera and Bassein further strengthened this position, enabling offshore western India to dominate national production through the 1980s and 1990s. As these assets matured, production gradually declined, and since the 2000s the focus has shifted toward enhanced oil recovery, redevelopment of aging infrastructure, and selective exploration in deeper waters.

The exceptional productivity of Mumbai High is rooted in its favourable geological setting within the Mumbai Offshore Basin. The field is situated on a structural basement high formed during the breakup of India and Madagascar, creating an elevated and stable platform conducive to carbonate deposition and reservoir preservation. Reservoirs comprise Miocene shallow-marine limestones with high porosity and permeability, enhanced by reef development, dissolution, and fracturing, enabling efficient fluid flow. Hydrocarbons are accumulated within a laterally extensive, simple anticlinal structure, supported by an effective petroleum system including mature source rocks, well-developed migration pathways, and regional shale seals.

This study presents a regional depositional framework derived from the integration of open-source geological and geophysical datasets with extensive well data across the entire west coast of India. A key component is the transformation of legacy 2D seismic data into a unified 3D-interpretable volume.

The database comprises multiple vintages of 2D seismic acquired between 1970's to 2010, merged into a single $2D^{cubed}$ volume covering approximately 773,000 km^2. This dataset provides a consistent foundation for basin-scale structural and stratigraphic interpretation and is calibrated using 65 exploration and appraisal wells to ensure robust geological control.

Detailed well analyses—including sequence stratigraphy, chronostratigraphy, lithostratigraphy, facies interpretation, and gross depositional environment (GDE) assessment—were integrated with seismic interpretation. Inputs from cuttings, core data, well correlations, seismic facies, and biostratigraphy were synthesized to generate calibrated facies distributions and regional GDE maps at key intervals of the petroleum system.

The results define the sedimentary evolution of the basin from the Base Deccan to the Middle Miocene, highlighting shifts in depositional fairways, sediment supply directions, and connectivity to deep-water systems. These findings provide new analogues, identify prospective stratigraphic intervals, and delineate potential exploration fairways in underexplored regions.

Although the seismic definition of the sub-decan remains challenging, the review of the area where wells penetrate reservoir quality rocks ‘sub deccan’ allows calibration of the seismic character and a detailed understanding of the heterogeneity.

Importantly, the study demonstrates that significant new insights can still be extracted from mature hydrocarbon provinces through innovative integration of legacy datasets. The availability of modern seismic data further enhances interpretation confidence, acting as both validation and refinement of the depositional model.

Overall, the results indicate substantial remaining potential for conventional hydrocarbon exploration, particularly within deeper-water domains that remain relatively underexplored.

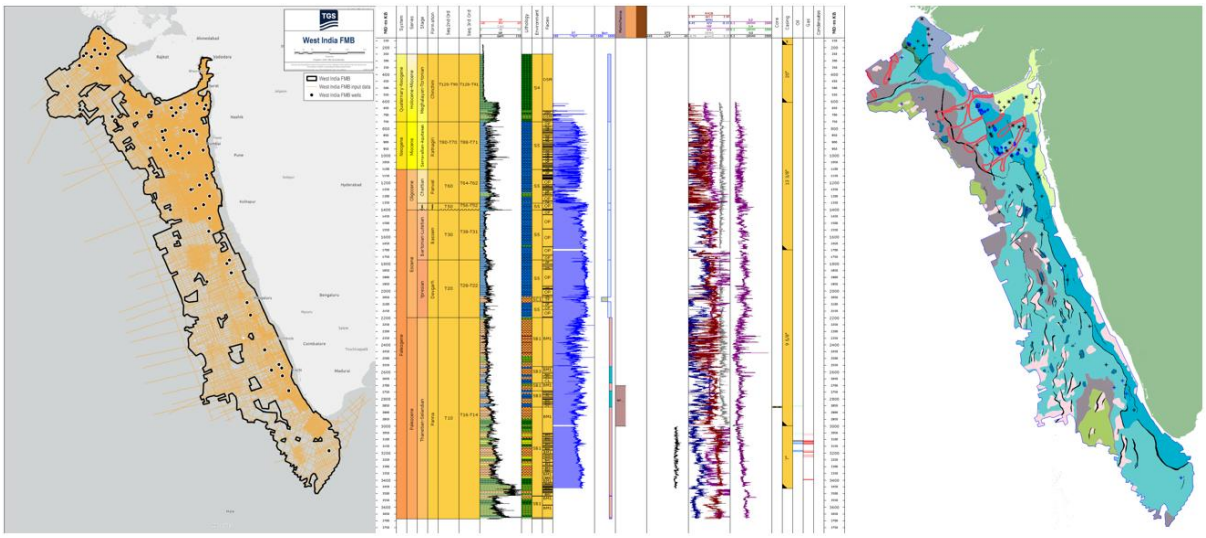

Figure 1. (Left) Project well location map and seismic input data, (Center) detailed stratigraphic well log viewer, and (Right) example facies/reservoir distribution map highlighting depositional variability and key reservoir trends.