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Mangala Field: A Seismic journey from Discovery to Development

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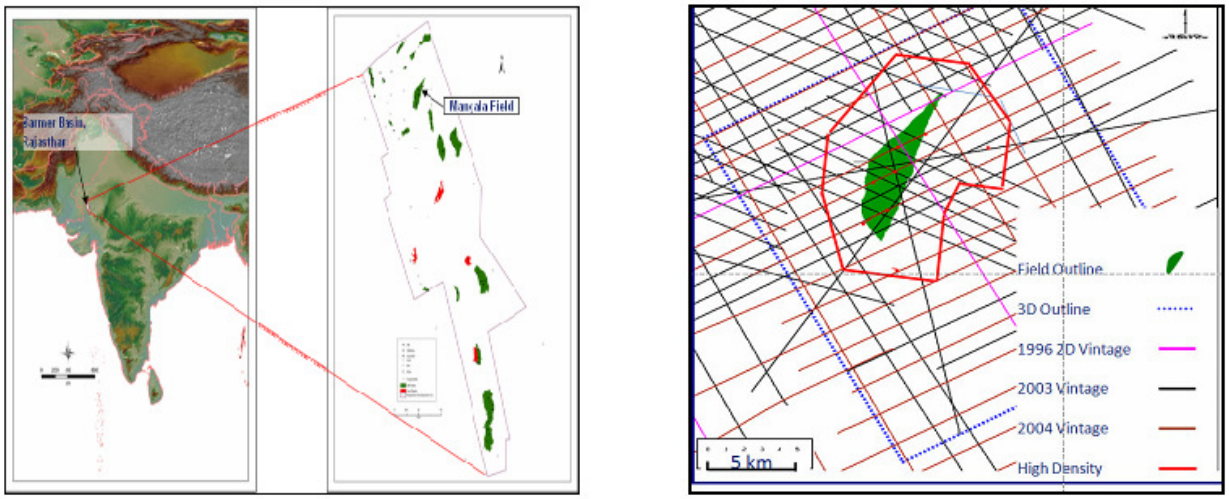
The Mangala field, in Northern Barmer basin of Rajasthan is the largest onshore discovery in India in last 25 years. Seismic history leading to the discovery and development of this world class field dates back to an initial 2D vibroseis survey in 1996. Subsequently, Cairn's semi regional grid in 2003 and an infill grid in 2004 led to discovery and appraisal of the Mangala and Aishwarya fields. Though the Mangala structure was identified, the proper imaging of faults remained a mystery. In 2004, a 455 square kilometer 3D survey with shot and receiver interval of 25m was acquired over the Mangala and Aishwarya fields. A Post stack time migration volume was generated and used for preparing the Field Development Plan (FDP), however the data at the crest of the field was poor, caused by low S/N ratio towards western bounding fault. This data was reprocessed using Prestack time migration (PSTM) in 2005. The results of this reprocessing clearly provided better imaging and further identification of internal faults, though it inherently suffered from poor S/N ratio and vertical resolution. In continuation of the above work a High Density Test 2D line was acquired over the crest in 2005, with shot and receiver intervals of 8m as compared with 24m in the original 2D surveys. The higher trace density helped in the design of better noise suppression filters, which was not achieved in the first 3D survey.

Deep upholes in which arrival times recorded by geophones in boreholes energized by surface source were acquired as part of this 2D test line, and these identified severe shallow velocity heterogeneity in the hanging wall side of the main bounding fault. Subsequently, an additional 50 deep upholes were drilled to a depth of around 150-200 meters to delineate the complex shallow velocity variations throughout the Mangala field for better static correction.

In pursuit of improving the seismic imaging a high density (HD) 3D survey was designed, acquired and processed to PSTM in 2007 using the improved static model for better imaging for detailed reservoir characterization. The improved noise suppression and shallow velocity information resulted in significantly better resolution in terms of defining the lateral continuity of the primary reservoir packages and proper imaging of low angle gravity and internal faults.

It also led to better imaging of the main bounding fault and provided refined velocity information. Initial development well planning was begun using this PSTM dataset.

In 2008, the information from earlier drilled wells and a further refined velocity model were used in controlled beam, Pre-Stack Depth Migration (PSDM) processing of the HD3D, which achieved further improvements in imaging the structure. The development drilling campaign began in 2009 and both of these HD3D volumes are used in that continuing programme and to improve reservoir characterization and modelling.



a b

Figure 1: a) Location map showing Mangala Field in Barmer Basin of Rajasthan
b) Dataset Map showing the various Seismic vintages acquired in the field

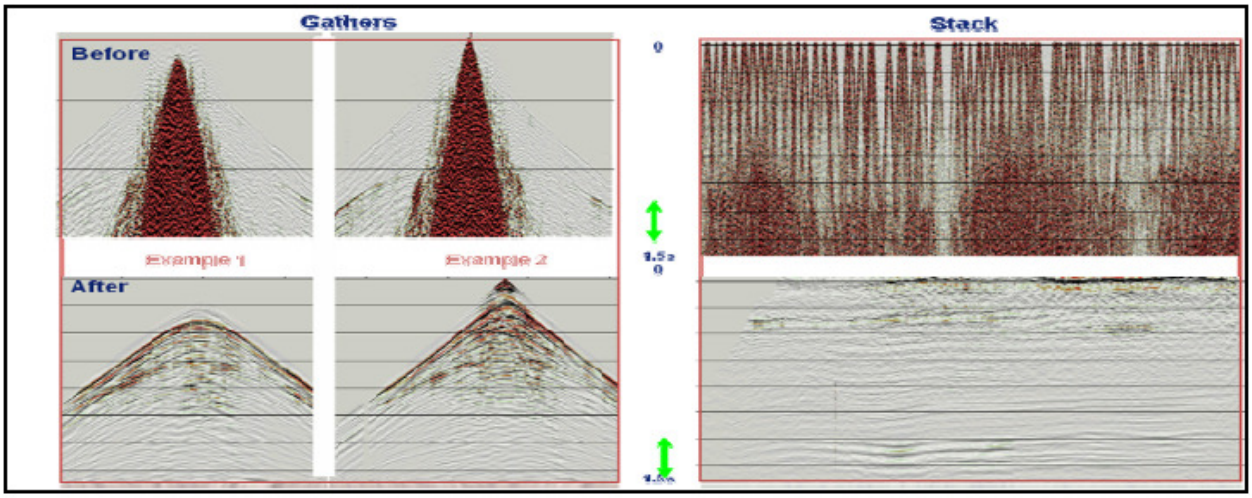


Figure 2: Comparison to show the results of HD 3D noise attenuation

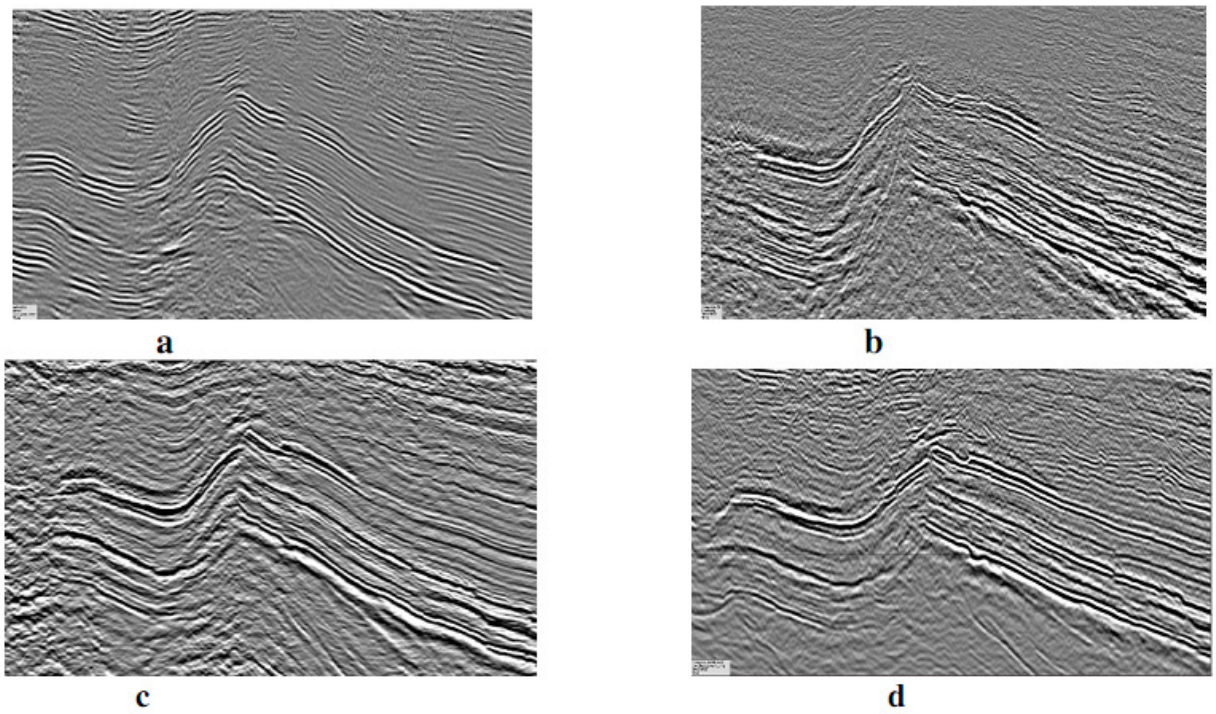


Figure 3: a) Initial 2D acquired, used to generate Post Stack data.
b) Initial 3D acquired, used to generate Post Stack time migrated volume.
c) Initial 3D acquired, reprocessed to Pre-Stack time migrated volume.
d) High Density 3D acquired and processed to Pre-stack time migrated volume.

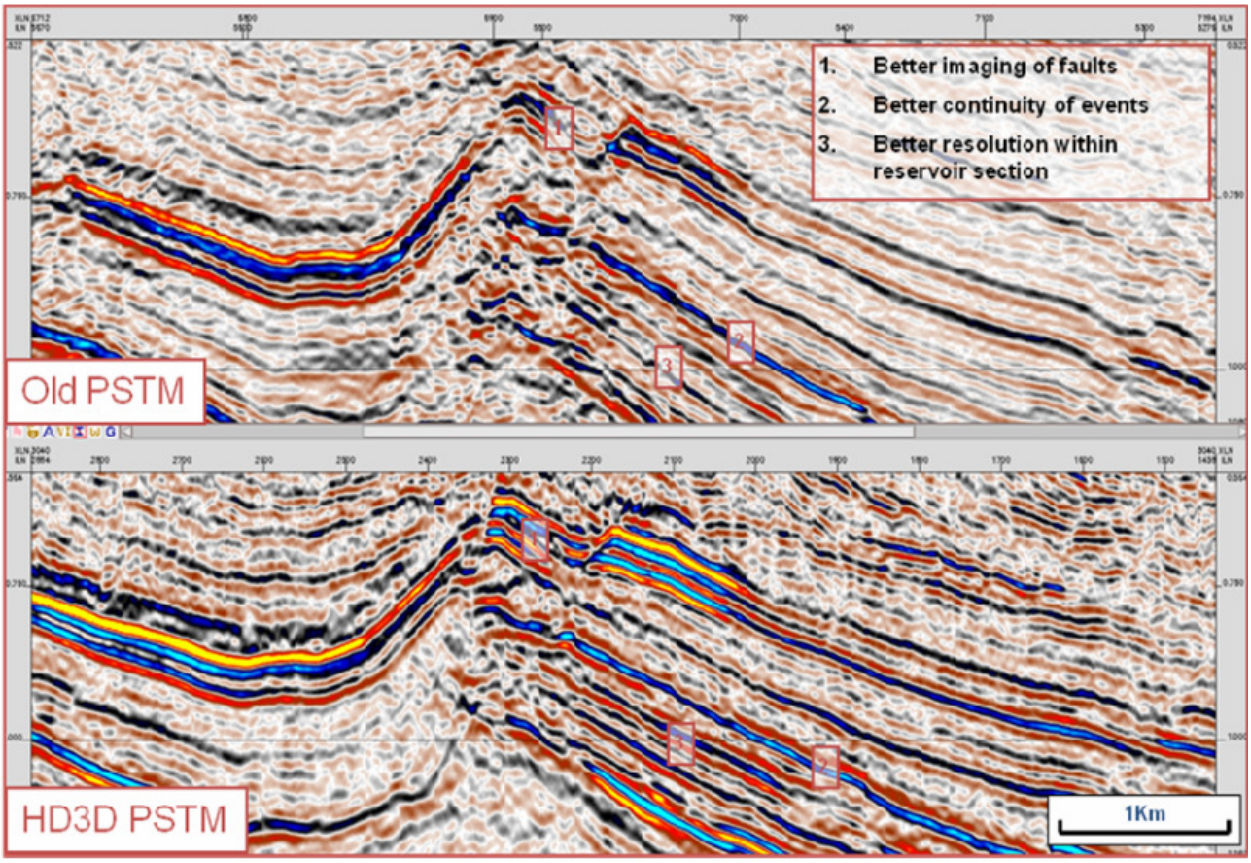


Figure 4: Mangala 3D Seismic comparison of old PSTM and HD3D PSTM