

## Basal Dharvi Dungar lacustrine turbiditic fan complex – New play identification using integral seismic attribute studies.

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### Keywords

Basal Dharvi Dungar, Lacustrine Turbidites, Seismic attributes, new play

### Abstract

Western margin basal Dharvi Dungar (DD) fan play was identified as a new play in Kaameshwari West area of Barmer Basin (RJONHP-2017/1 block). The play comprises of a series of coalesced lacustrine turbidite fan bodies within the Lower Dharvi Dungar (Lower DD) formation. The drilled interval of Lower Dharvi Dungar reservoir in Durga-1 and DD-FB-2 wells was further divided into lower DD3 and upper DD1 packages. DD1 reservoir are thinly laminated sands deposited as fan over a large area, however, DD3 sands are thicker and mounded in nature. The direction of reservoir fairways (Figure 1) is from the western basin margin area travelling east wards and getting deposited in the hanging wall of the Kaameshwari field. These reservoir intervals proved to be Hydrocarbon bearing and establishes a working petroleum system in a new Lower DD play. Multiple seismic attribute studies along with seismic inversion and machine learning (ML) based lithology classification, indicate the extent of this play over a large area in western margin corridor of central Barmer basin.

### Introduction

The Western Margin basal Dharvi Dungar prospect could be defined as a complex combination of structural and stratigraphic elements. This prospect is covered mostly by legacy multiple 3D seismic and vintage 2D seismic data. The Basal Dharvi Dungar reservoir unit is a turbidite fan system. Reservoir units within this formation were charged from matured Barmer Hill and from Lower Dharvi Dungar source rocks, which are excellent source rocks in the basin as established from the nearby kitchen.

The Top seal for the Basal Dharvi Dungar (DD1 and DD3) reservoir relies on intraformational shales of

the Lower Dharvi Dungar, Mandai Shale equivalent. The lateral seal along the western closure is for the most part fault-bounded and juxtaposed against older shales of the Barmer Hill Formation for the basal DD3 reservoir. This also acts as the base seal for this formation. Containment in the northernmost part of the DD3 reservoir is reliant upon stratigraphic pinch-out where the fault throw wanes and thus top and lateral seal in this area is intra-formational by Lower Dharvi Dungar Mandai Shales.

### Reservoir body identification through seismic data attribute studies

Windowed amplitude attribute maps coupled with thickness map generated from the top and base of basal DD formation clearly brought some predominantly West-East trending long linear fanning out anomalous amplitude bodies.

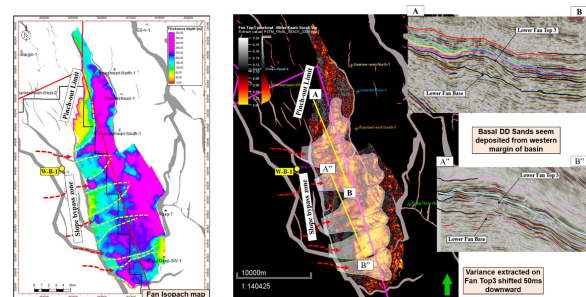


Figure 1: Reservoir depositional identification based on isopach maps and Variance maps.

To further validate these stratigraphic features and to better understand reservoir facies distributions, an integral approach was adopted in relating the seismic data with a combination of seismic attributes (Figure 1) like Variance, RMS amplitude, RAI, instantaneous frequency, and spectral blending. This has further been corroborated with the petrographic studies using



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sidewall cores from basal DD formation to understand the reservoir quality, depositional setting, and post-depositional diagenetic changes.

Exploration well Durga-1 drilled the entire DD1 interval and partially DD3 interval, however, the DD3 interval was not positioned suitably to evaluate and test the zone. The 2nd exploration well DD FB-2 was planned in the updip to test hydrocarbon potential of turbiditic sands Lower Dharvi Dungar fan (DD3) (Figure 2).

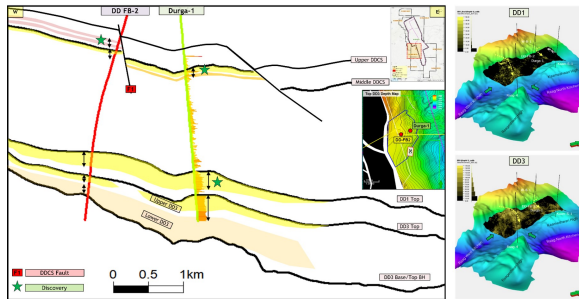


Figure 2: Seismo geological section passing through DD-FB2 and Durga-1 wells and representing Basal Dharvi Dungar (DD1 Top and DD3 Top) and reservoir depositional model represented by RAI attribute of DD1 and DD3 over Barmer Hill surface.

DD1 and DD3 sands which are turbiditic in nature have multiple sand shale intercalations within the interpreted package thickness and the lateral extents of these sands vary (Figure 3).

Unlike DD1 sands, DD3 sands are quite thicker, while some sands of DD3 formation in Durga-1 have HC indications on LFA, the sands within the same interval, are water wet in the updip direction in DD FB-2 well, indicating that the intermittent sands pinchout in updip direction. Seismically these individual sands extent is not laterally traceable.

The basal DD reservoirs are dominated by fine to medium grained sandstones. Petrographic study confirms these sandstones as quartz dominated lithic arenites and reveals their low textural maturity. Quartz overgrowths are present locally and kaolinite is the dominant clay occluding the pore throats as indicated from XRD analysis (Figure 4 and Figure 5).

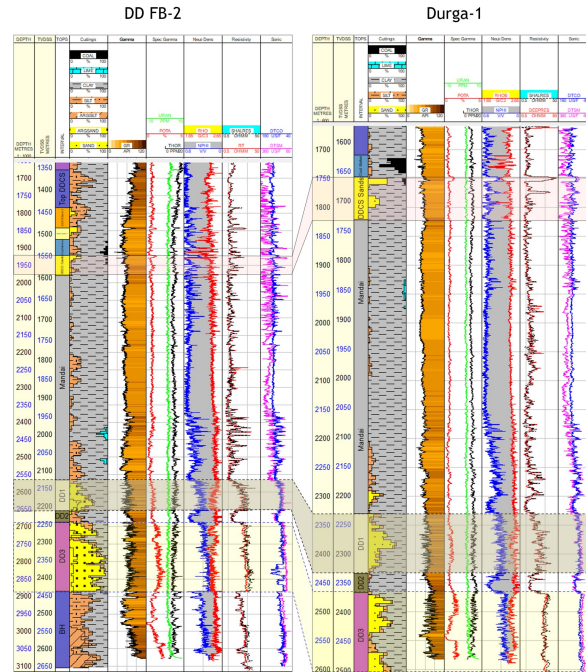


Figure 3 Well Correlation of DD1 and DD3 reservoirs between Durga-1 and DD FB-2

Reservoir quality in the top part of basal DD turbidites is likely to be poor with very low visible porosity, primarily due to poor sorting of turbiditic sands and high detrital clay content.

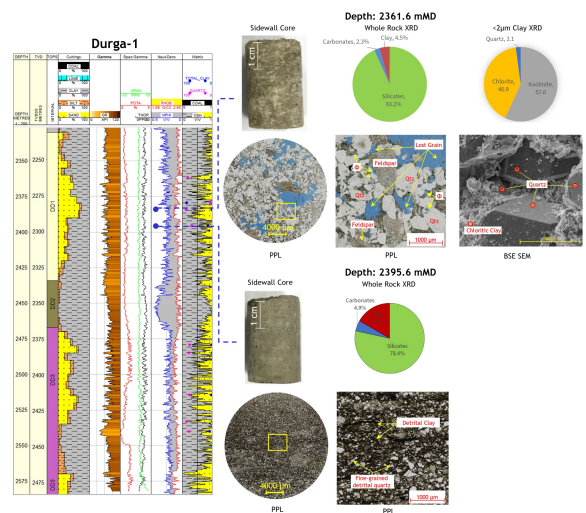


Figure 4: Petrographic analysis of DD1 reservoirs in Basal DD interval





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The geological model postulated with seismic is calibrated with petrophysical data and the Modular formation Dynamics Tester (MDT) along with well test results. The model, validated by the working petroleum system in the two exploration wells drilled in the area, has established that systematic workflow adopted through integrated analysis of seismic attributes is the key in defining reservoir geometry and resulting in deciphering a new stratigraphic play in Lower Dharvi Dungar formation.

Offshore); Soumen Dasgupta, Head Exploration Western Onshore; Biswanath Ghosh, Director Exploration

This opens a new Dharvi Dungar turbidite play in the Western Basin Margin corridor of central Barmer Basin with a working petroleum system as established by Durga discovery. An extended study using seismic inversion and ML based lithology classification helped in identifying similar reservoir nature in BH formation and supported in delineating the turbiditic body as a prospective location for further drilling.

Some key takeaways are:

- An integrated approach using advanced geophysical techniques, robust geological model helped to identify a new play concept in the well explored Barmer Basin.
- The recent work aided to discover and unlock a new field in the western margin area under the OALP regime.
- The seamless integration of multiple seismic datasets with the existing discoveries in the basin is helping us to conceptualize new Plays and Cairn always takes a Play based exploration approach which has resulted in 3 discoveries in 3 wells in OALP block-1 so far.
- We have built a robust portfolio of multiple Play Types and are well poised to chase them one after another.

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