



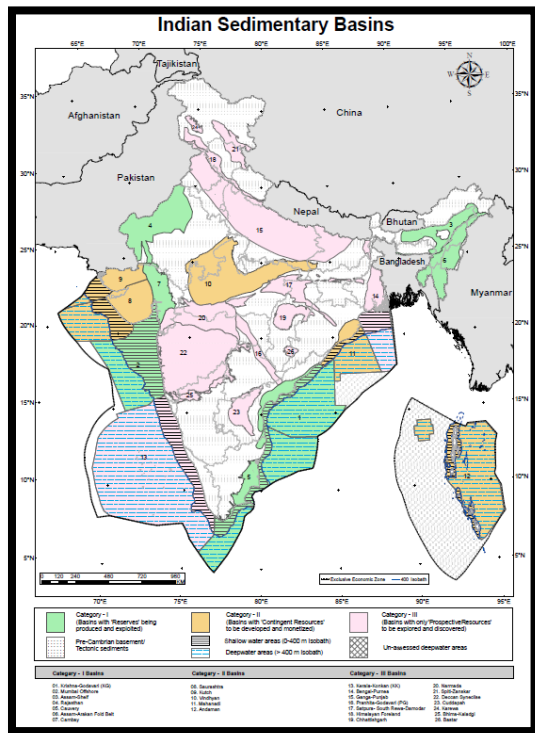
Technical Overview of Exploration Blocks-on-Offer (OALP Bid Round V)

Presentation outline

- ❑ Indian Sedimentary Basins
- ❑ Hydrocarbon Resource Reassessment Study
- ❑ Blocks-on-offer
- ❑ Basin-wise Brief of Blocks-on-offer
- ❑ Summary

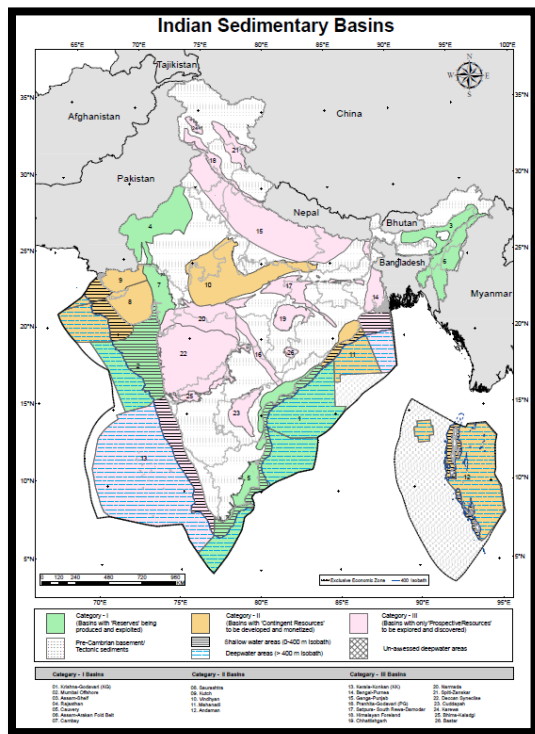
INDIAN SEDIMENTARY BASINS

Basin category



- A new 3-tier category for 26 basins
- A simplified approach to present the Category based on the **maturity of resources** in line with PRMS standard
- **Category I:** 7 basins which are commercially producing from established petroleum resources (“**RESERVES**”)
- **Category II:** 5 basins which have established petroleum resources but are yet to produce commercially (“**CONTINGENT RESOURCES**”)
- **Category III:** 14 basins which have prognosticated resources but still to be discovered (“**PROSPECTIVE RESOURCES**”)

Basins under different categories



Category I

- **Krishna-Godavari(KG), MUMBAI OFFSHORE*, ASSAM SHELF*, RAJASTHAN*, CAUVERY*, Assam-Arakan Fold Belt and CAMBAY***

RESERVES

CONTINGENT

PROSPECTIVE

Category II

- **SAURASHTRA*, KUTCH***, Vindhyan, Mahanadi and Andaman

CONTINGENT RESOURCES

PROSPECTIVE RESOURCES

Category III

- **BENGAL-PURNEA*(†)**, Kerala-Konkan, Ganga-Punjab, Pranhita-Godavari(PG), Satpura-South Rewa-Damodar, Himalyan Foreland, Chhattisgarh, Narmada, Spiti-Zaskar, Deccan Syneclise, Cuddapah, Karewa, Bhima-Kaladgi and Bastar

PROSPECTIVE RESOURCES

**Shown in bold caps are 'Eight' target basins under Round V Offer*

†Under upgrade to Category II

Basin category (Area and Inplace)

- **Total area:** 3.36 million sq.km.
- **On land:** 1.63 million sq.km.
- **Offshore (Shallow):** 0.41 million sq.km. (up to 400-m water depth)
- **Offshore (Deep and Ultra-deep):** 1.32 million sq.km. (beyond 400-m water depth, limited to basin/EEZ boundary)

| Category | Basins | Type of Basins | Area (in sq.km.) | Conventional Petroleum Inplace (MMTOE) |
|----------|--------|---|---------------------|--|
| I | 7 | Basins with RESERVES being produced and potential to be exploited at increased recovery | 998,325 (30%) | 35,511 (85%) |
| II | 5 | Basins with CONTINGENT resources to be developed and put on production | 780,974 (23%) | 3,877 (9%) |
| III | 14 | Basins with only PROSPECTIVE resources to be intensively explored and discovered | 1,586,150 (47%) | 2,481 (6%) |
| | 26 | Total | 3,365,449 | 41,871 |

HYDROCARBON RESOURCE REASSESSMENT STUDY

Overview of the study

- During 2017-18, hydrocarbon reassessment was carried out for all 26 basins
- **Assessment done for conventional reservoirs only**
- Reviewed by international domain-specialists and Indian basin-experts
- 13 basins with adequate datasets were assessed through “Petroleum System Modeling”
 - 9 basins (Assam Shelf, Cambay, Rajasthan, Mumbai, KG, Cauvery, Mahanadi, Bengal-Purnea and Kerala-Konkan) : Entire area
 - 4 basins (Assam Arakan, Andaman, Kutch and Saurashtra) : Part area
- **177 hydrocarbon plays were identified**
 - 87 in Tertiary, 53 in Mesozoic and 37 Pre-Mesozoic
- **New plays included**
 - Mesozoic reservoirs in 14 basins
 - Basement fractures in many new discoveries

Results of the Study

- Last assessment done in 1995-96 for 15 sedimentary basins :
 - Total Inplace assessed: 28,085 MMTOE (206 BBBLOE)
 - Deepwater separately assessed with 7,000 MMTOE inplace
- Current assessment done for all 26 basins with deepwater areas included
 - Inplace Reassessed: 41,872 MMTOE (307 BBBLOE), including 11 basins not earlier assessed with 868 MMTOE inplace
 - Discovered: 12,076 MMTOE (89 BBBLOE)
 - **Undiscovered: 29,796 MMTOE (218 BBBLOE), 71% of the total inplace**
- **Increase of total hydrocarbon estimate: 49.1%**
- Reassessment at **hydrocarbon play** level
- A complete **geoscientific database** with subsurface models, maps and reports

Results compared

1995-96 study

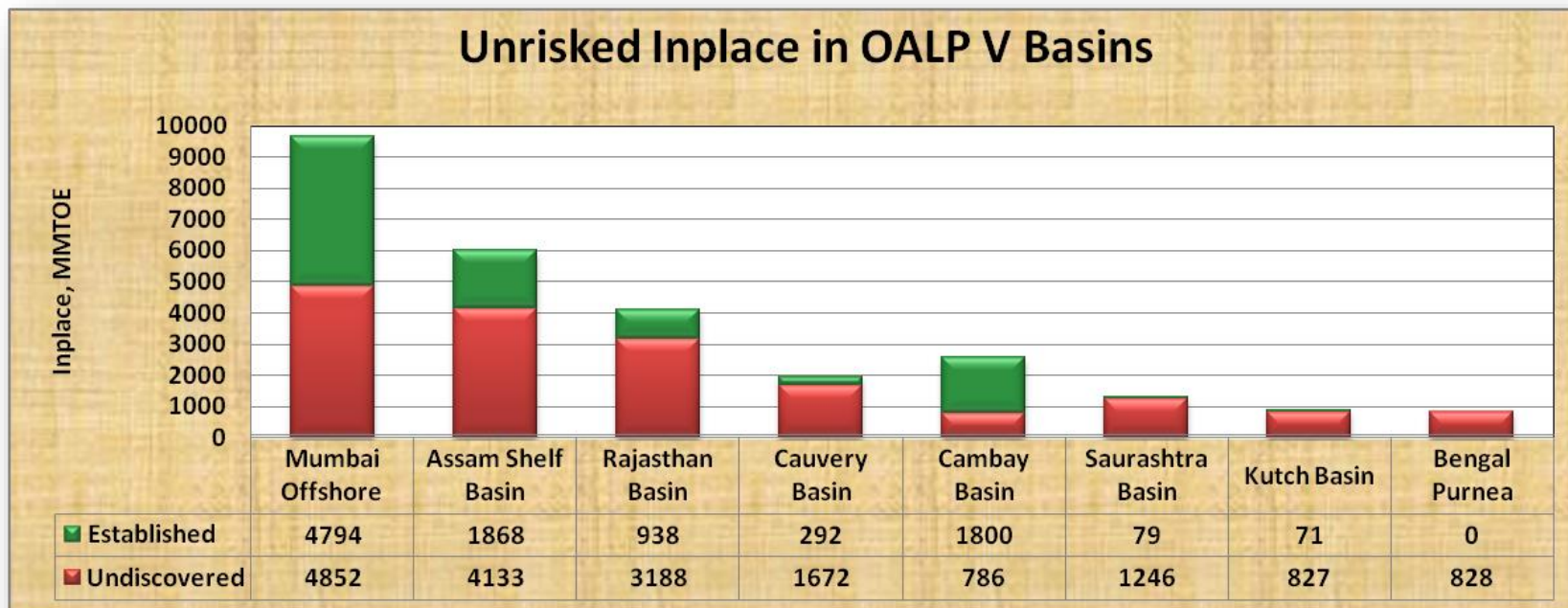
- ☐ Carried out for 15 basins
- ☐ Simplistic tools and limited datasets
- ☐ Areal Yield (AY) method used for all basins
- ☐ Assessment at 'basin' level
- ☐ Deepwater areas excluded and assessed separately

2017-18 study

- ☐ All 26 basins re-assessed
- ☐ Sophisticated tools and expanded datasets
- ☐ 13 basins/basin areas with enough datasets were assessed through 3D petroleum system modeling
- ☐ Assessment at 'play' level
- ☐ Deepwater included and assessed with basins

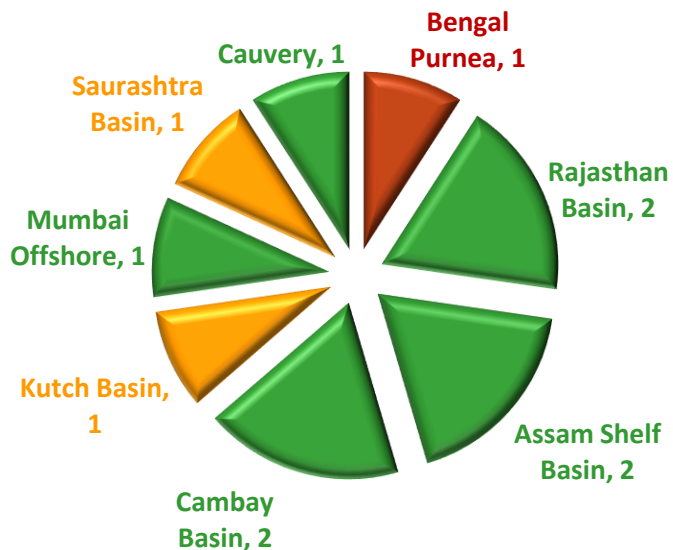
BLOCKS-ON-OFFER

Basin-wise Hydrocarbon Inplace



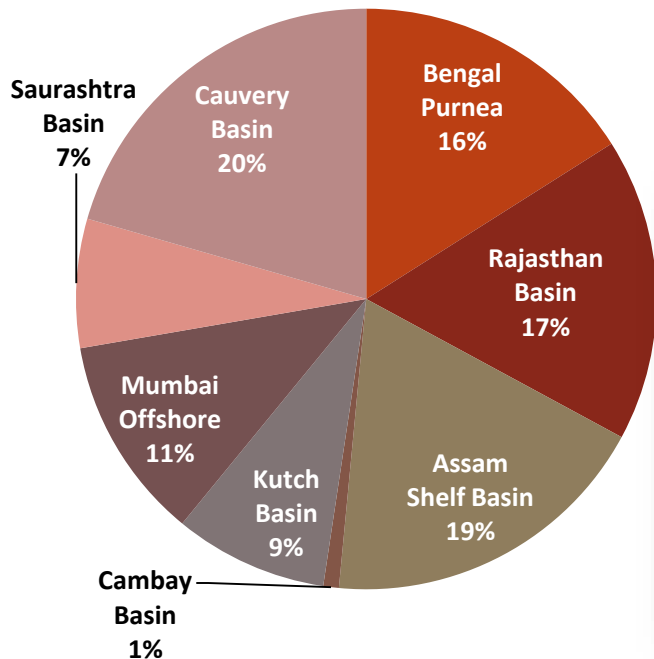
Note: Bengal-Purnea is under category-upgrade with discovered inplace

OALP Blocks across Basins

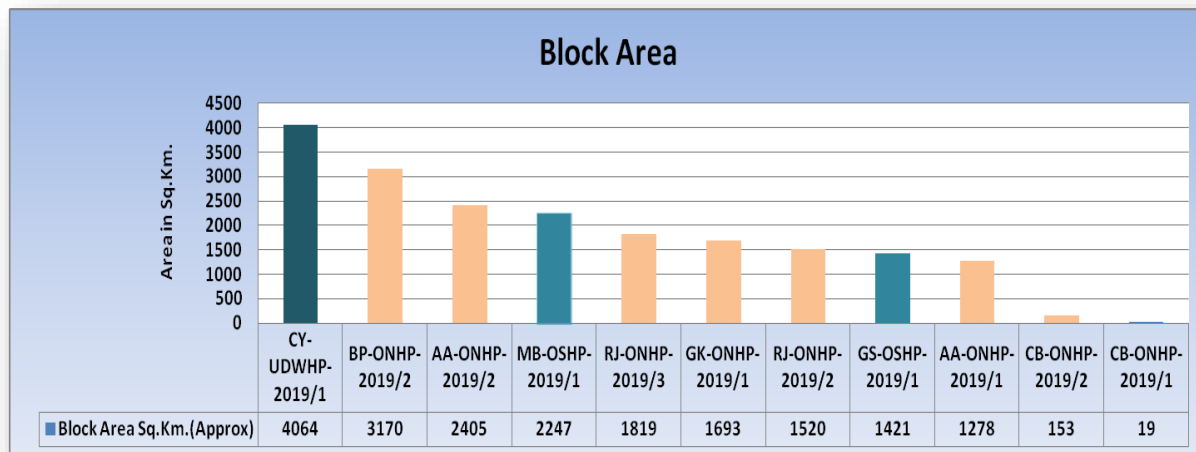


- ❑ **Total 11 blocks on offer**
 - ❑ **Distributed in 8 sedimentary basins**
 - ❑ **Rajasthan, Cambay and Assam shelf have 2 blocks each**
-
- ❑ **8 blocks from Category I basin**
 - ❑ **2 blocks from Category II basin**
 - ❑ **1 block from Category III basin**

Basin Area across Blocks

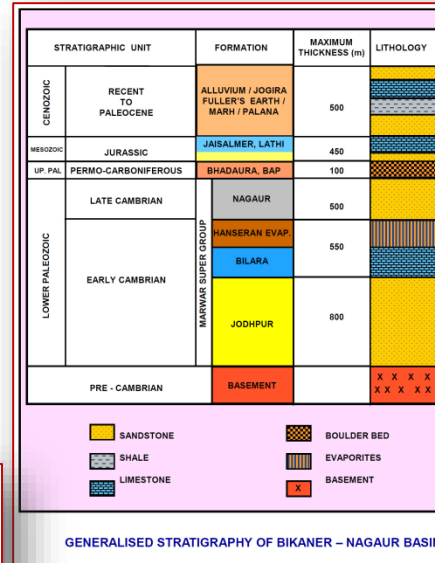
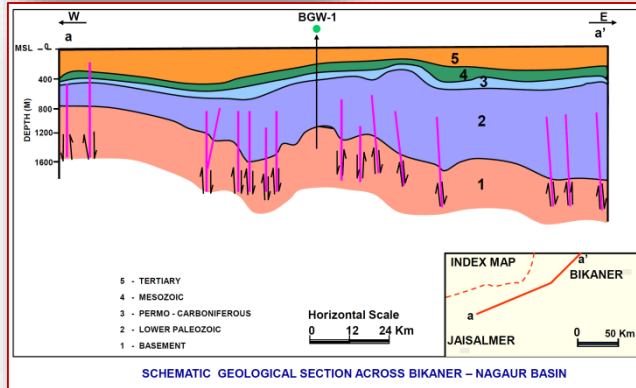
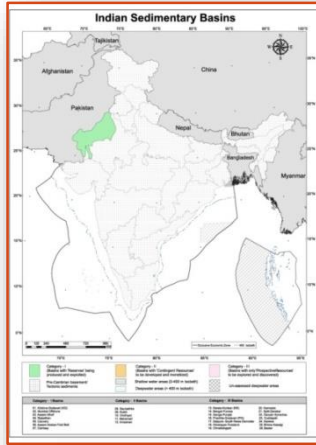


- ❑ Total area 19,789 Sq. Km.
- ❑ Cauvery Basin has maximum acreage with ultra-deepwater area
- ❑ Mumbai and Saurashtra Basin have shallow water area
- ❑ Other basins have onland acreage on offer

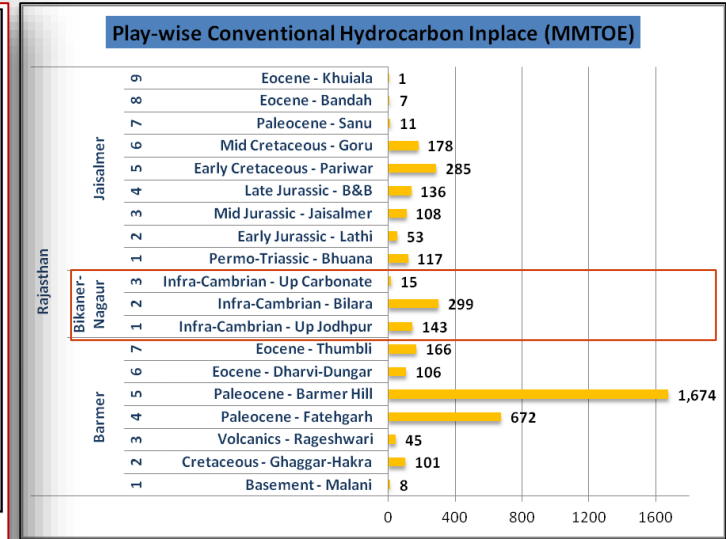


BASIN-WISE BRIEF OF BLOCKS ON OFFER

RAJASTHAN (BIKANER-NAGAU SUB-BASIN)



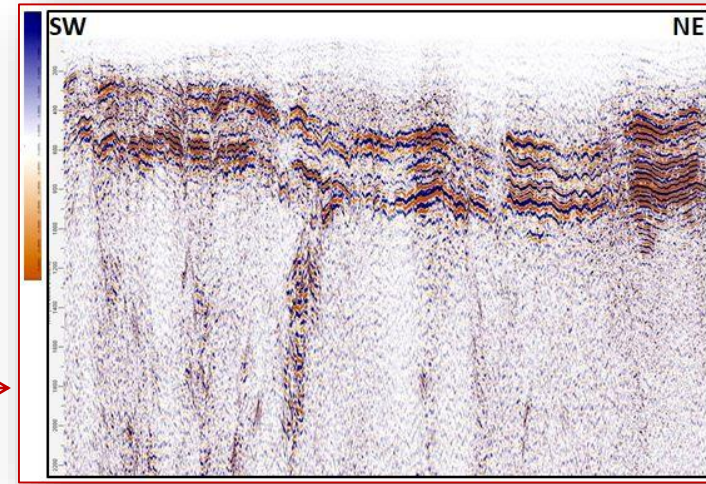
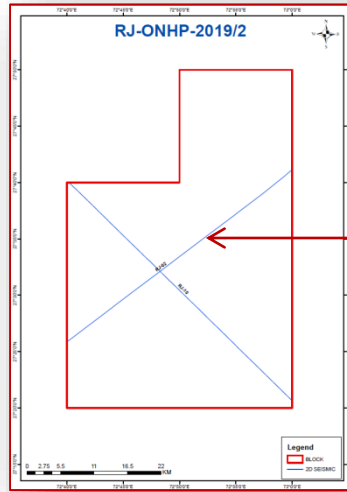
GENERALISED STRATIGRAPHY OF BIKANER - NAGAU SUB-BASIN



Prognosticated Resources (In-place MMTOE)

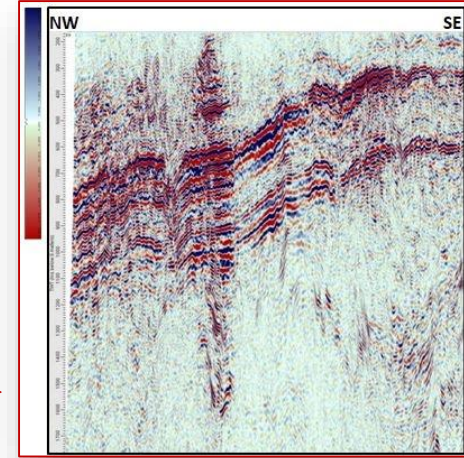
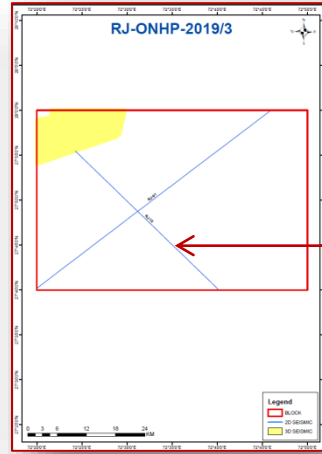
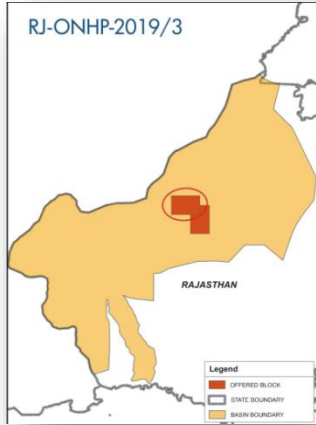
| Discovered | Undiscovered | Total |
|---------------------|--------------|--------|
| 15 | 443 | 458 |
| Total Area (Sq.Km.) | | 77,500 |

- Blocks-on-offer: 2
- Area: 3,340 sq km



RJ-ONHP-2019/2:

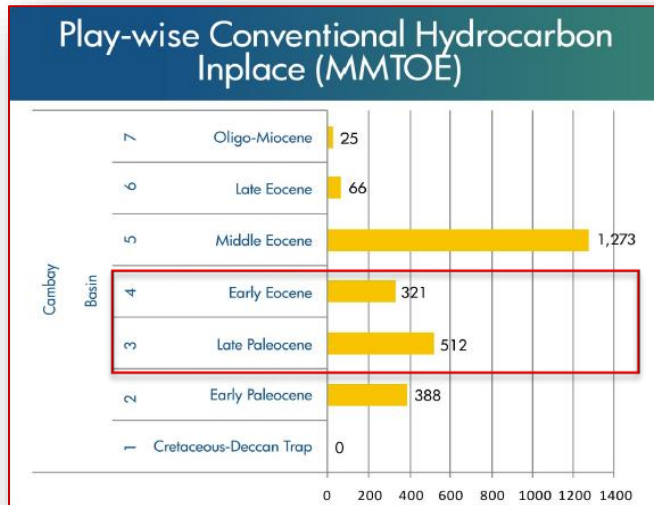
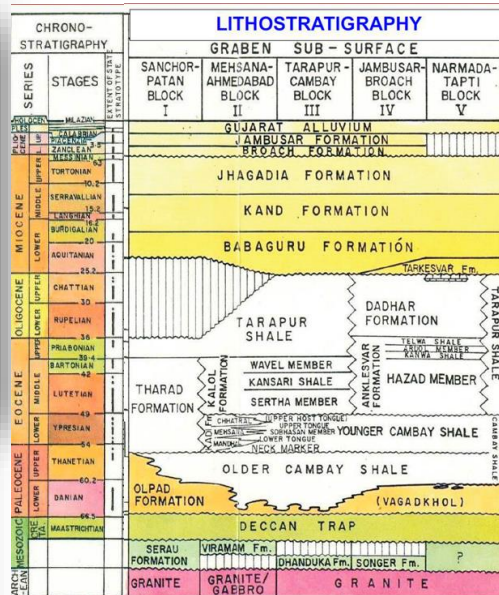
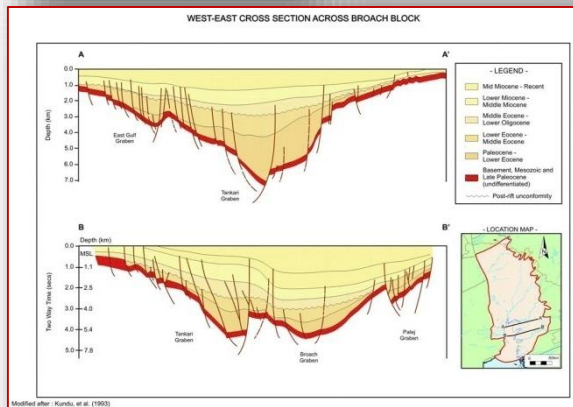
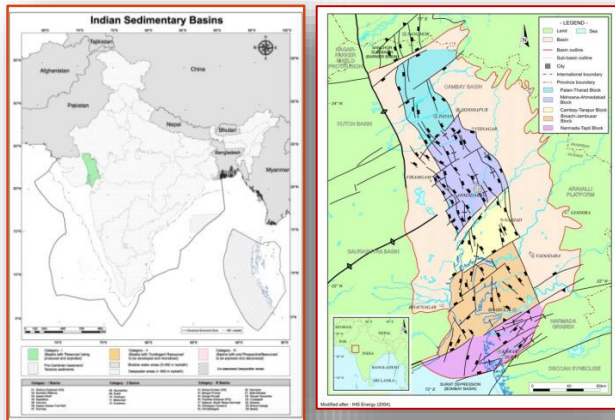
- ☐ Jodhpur and Upper Carbonate are identified plays
- ☐ In the sub-basin, these 2 plays have estimated inplace of 143 MMTOE (Jodhpur) and 15 MMTOE (Upper Carbonate)
- ☐ Sandstone reservoirs of Jodhpur Formation are believed to be charged from source rocks of Bilara Formation, - an established fact from Bagheewala discovery of heavy oil
- ☐ Target depth for wells: 500 m
- ☐ Area: 1,520 Sq. Km. | Datasets: 2D seismic



RJ-ONHP-2019/3:

- ☐ Jodhpur and Upper Carbonate are identified plays
- ☐ In the sub-basin, these 2 plays have estimated inplace of 143 MMTOE (Jodhpur) and 15 MMTOE (Upper Carbonate)
- ☐ Sandstone reservoirs of Jodhpur Formation are believed to be charged from source rocks of Bilara Formation, - an established fact from Baghewala discovery of heavy oil
- ☐ Target depth for wells: 800 m
- ☐ Area: 1,819 Sq. Km. | Datasets: 2D seismic, 3D seismic

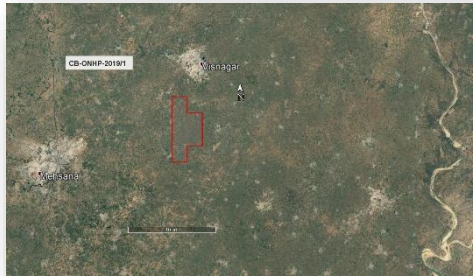
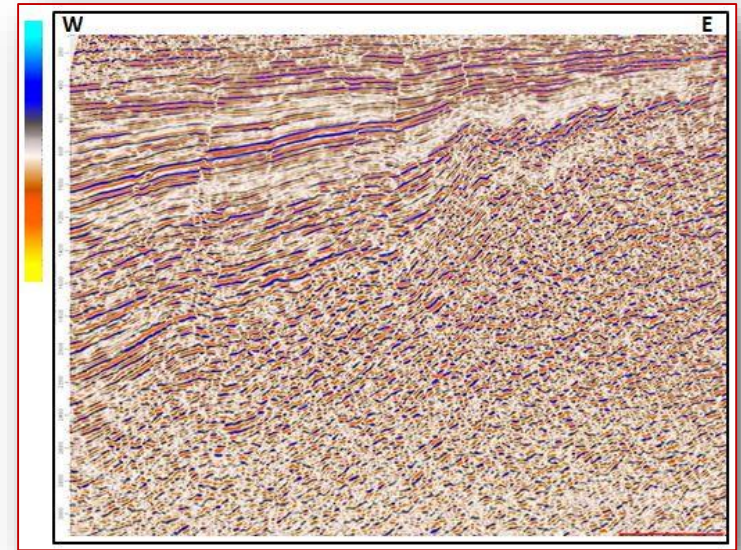
CAMBAY BASIN



| Prognosticated Resources (In-place MMTOE) | | |
|---|--------------|-------|
| Discovered | Undiscovered | Total |
| 1800 | 786 | 2586 |
| Total Area (Sq Km) | 53,500 | |

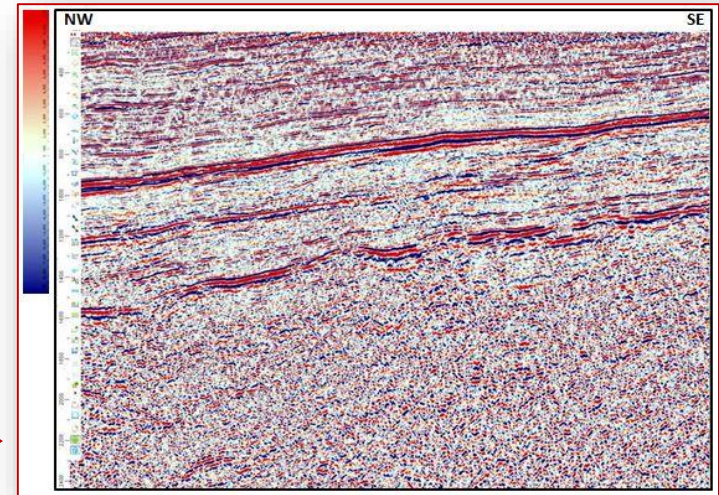
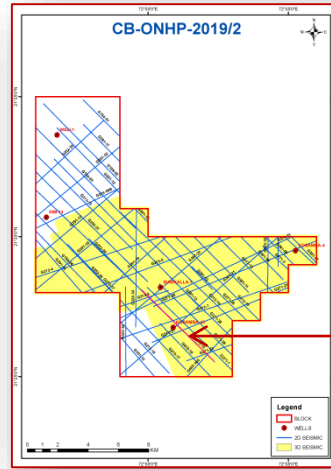
- Blocks-on-offer: 2
- Cumulative area: 172 sq km

CB-ONHP-2019/1



CB-ONHP-2019/1:

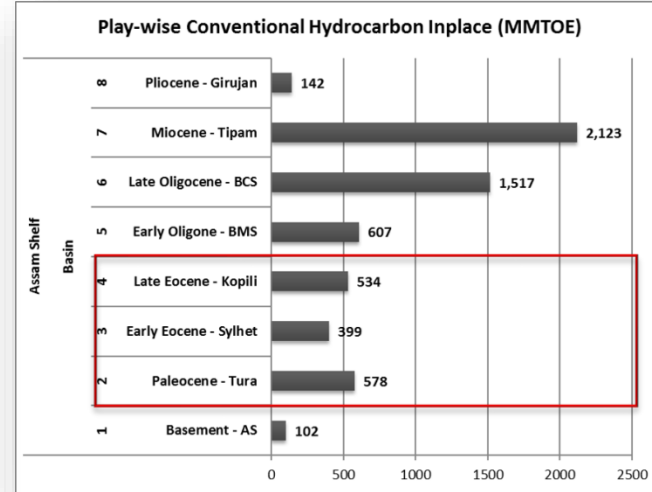
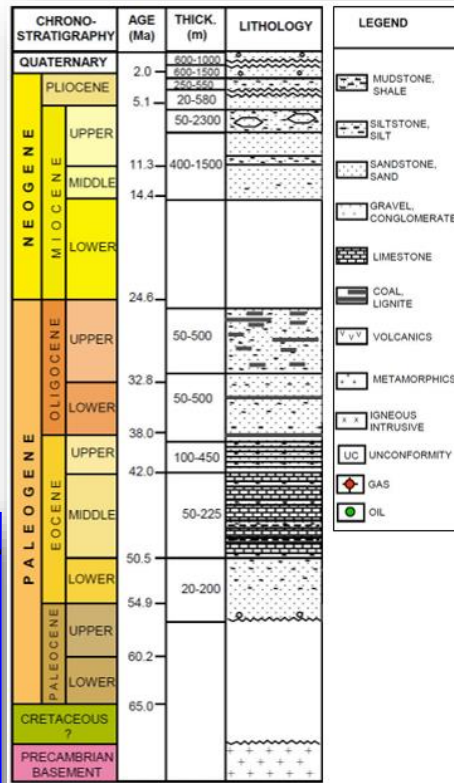
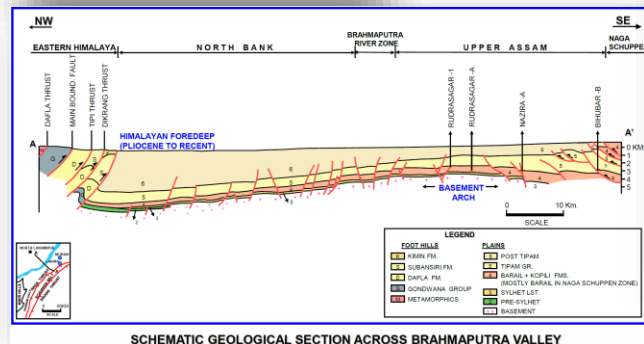
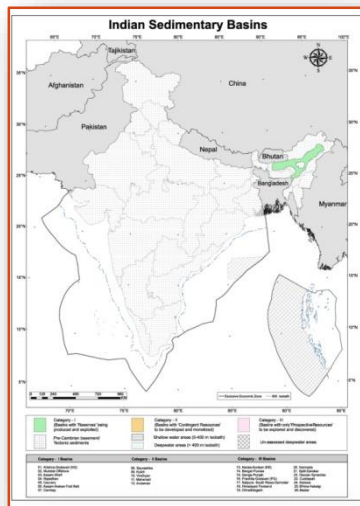
- ❑ Located in the northern part of the Cambay Basin in Ahmedabad-Mehsana-Block, surrounded by Sobhasan Field to the west and Mansa Field to the south-east
- ❑ Occurrence of heavy oils in nearby wells of Pre-NELP CB-ON/3 block
- ❑ Identified hydrocarbon plays : Kadi, Olpad Formation and fractured/weathered trap.
- ❑ Target depth for wells: 1,200 m
- ❑ Area: 19 Sq. Km. | Datasets: 2D seismic, 3D seismic, 3 wells, reports



CB-ONHP-2019/2:

- ☐ Located in the northern part of Narmada-Tapti Block of Cambay Basin surrounded by many discovered fields like Ankleshwar, Kosamba, Motwan, West Motwan, Sisodra, Elao and Kim
- ☐ The petroleum system identified in south Cambay Basin indicate multiple source rocks
- ☐ Identified hydrocarbon plays: Paleocene/Early Eocene and Early/Middle Eocene
- ☐ Target depth for wells: 1,000 m
- ☐ Area: 153 Sq. Km. | Datasets: 2D seismic, 3D seismic, 5 wells, reports

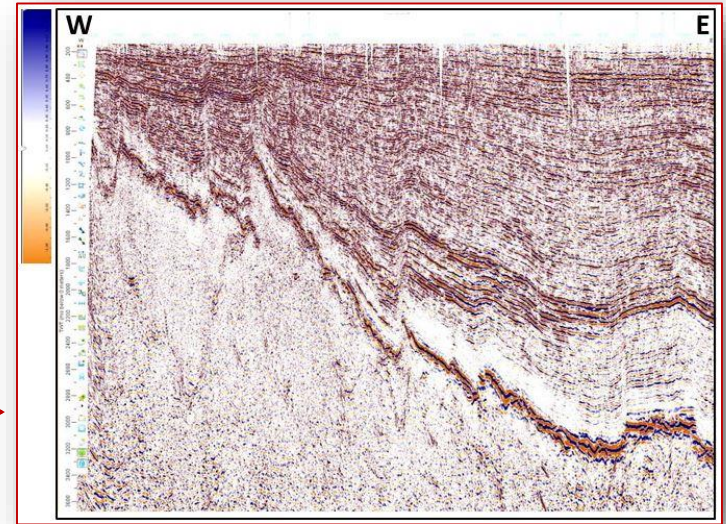
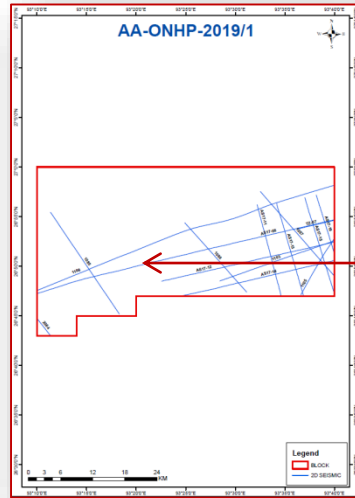
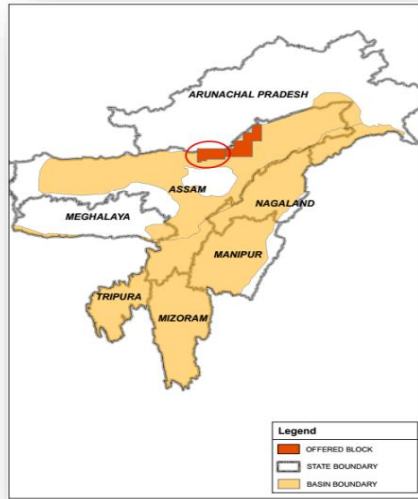
ASSAM SHELF BASIN



| Prognosticated Resources (In-place MMTOE) | | |
|---|--------------|-------|
| Discovered | Undiscovered | Total |
| 1868 | 4133 | 6001 |
| Total Area(Sq Km) | 56,000 | |

- Blocks-on-offer:2
- Cumulative area: 3,683 sq km

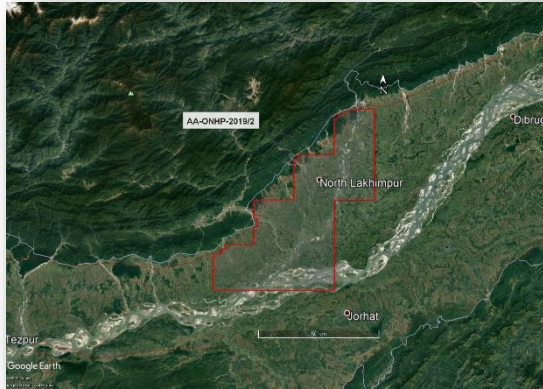
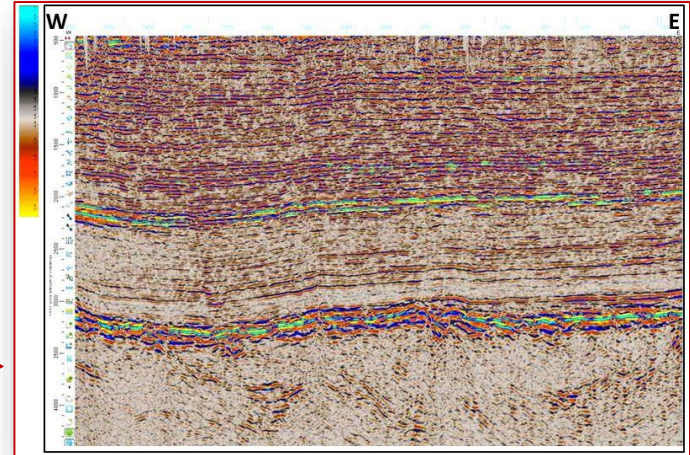
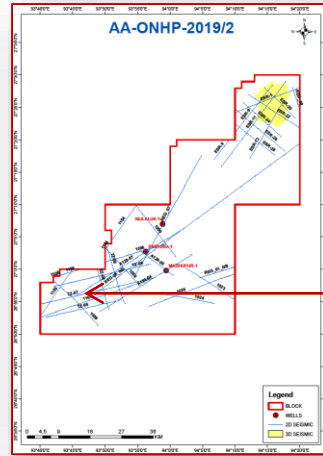
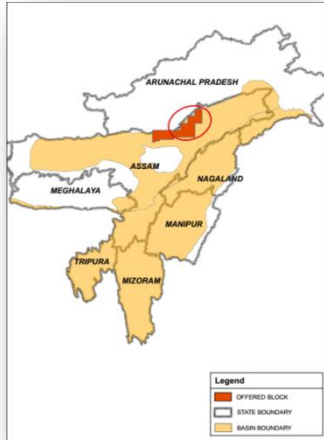
AA-ONHP-2019/1



AA-ONHP-2019/1:

- ☐ Located north of Kaziranga National Park in the north bank of the river Brahmaputra
- ☐ Reservoirs are believed to be charged from Paleocene-Eocene source rocks with expected entrapments as fault-bound-to-four way closures. Few shallower targets within Oligo-Miocene are envisaged to be secondary targets
- ☐ Identified hydrocarbon plays: Paleocene-Eocene
- ☐ Target depth for wells: 4,000 m
- ☐ Area: 1,278 Sq. Km. | Datasets: 2D seismic.

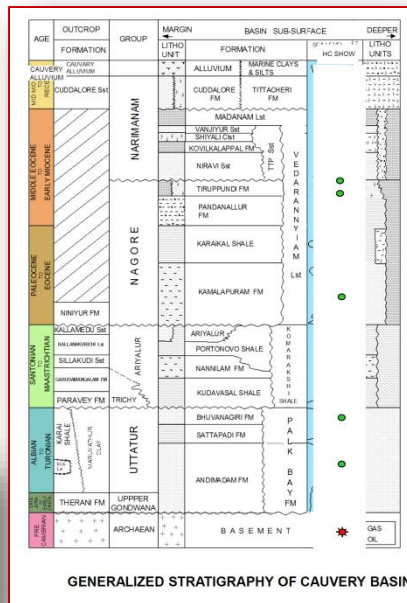
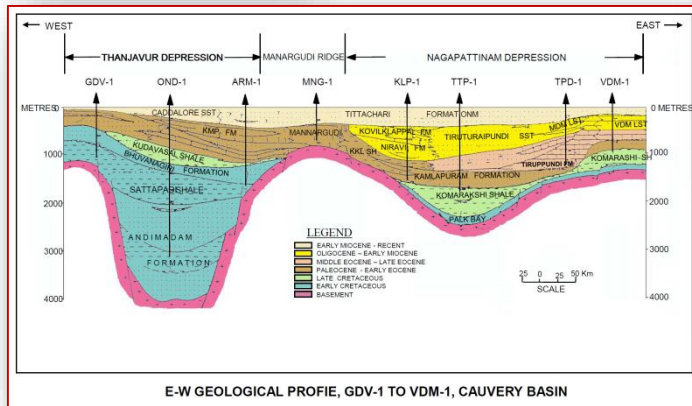
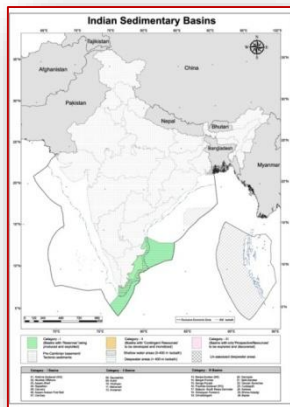
AA-ONHP-2019/2



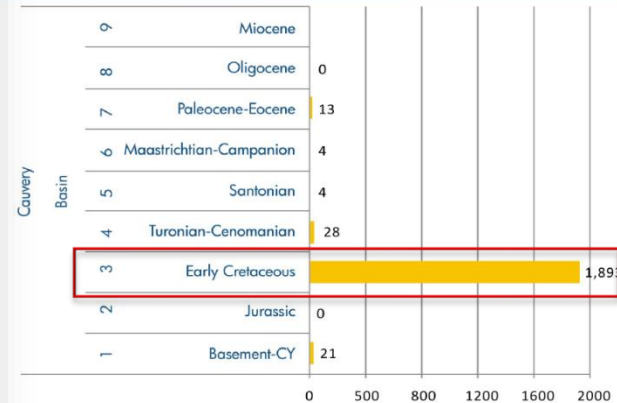
AA-ONHP-2019/2:

- ❑ Located in Lakhimpur area on the north bank of the river Brahmaputra.
- ❑ Reservoirs within the Paleocene-Eocene Formation (high reflective package above basement) is the primary exploration target. These reservoirs are expected to be charged from source rock of Palaeocene-Eocene Formation (Kopili and Lakadon). Expected entrapments are fault bound closures
- ❑ Identified hydrocarbon plays: Paleocene-Eocene
- ❑ Target depth for wells: 3500 m
- ❑ Area: 2,405 Sq. Km. | Datasets: 2D seismic, 3D, seismic, 3 wells, reports.

CAUVERY BASIN



Play-wise Conventional Hydrocarbon Inplace (MMTOE)

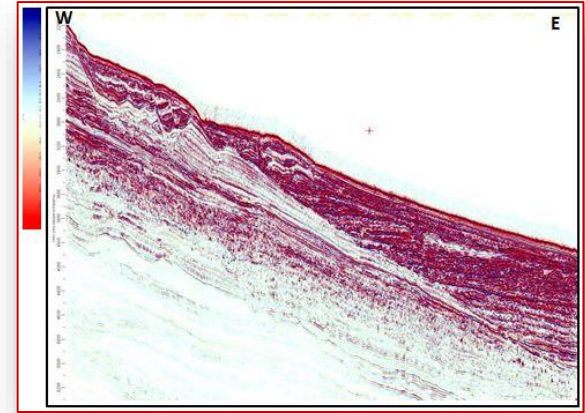
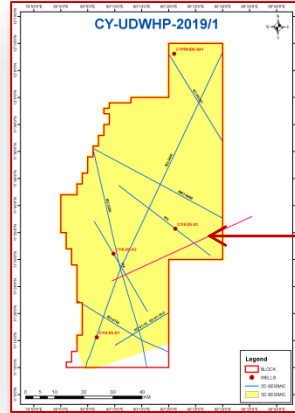
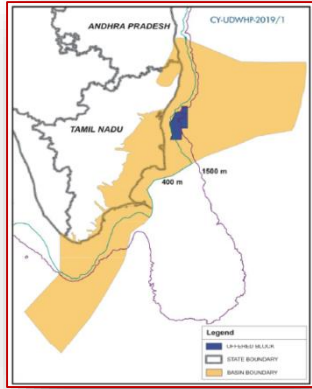


Prognosticated Resources (In-place MMTOE)

| Discovered | Undiscovered | Total |
|--------------------|--------------|-------|
| 292 | 1672 | 1964 |
| Total Area (Sq Km) | 240,000 | |

- Block-on-offer: 1
- Cumulative area: 4,064 sq km

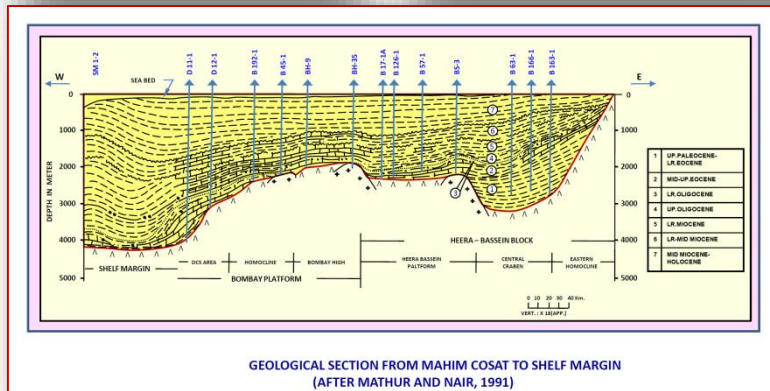
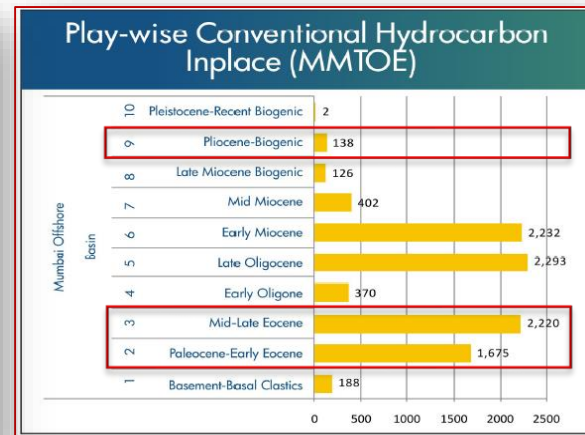
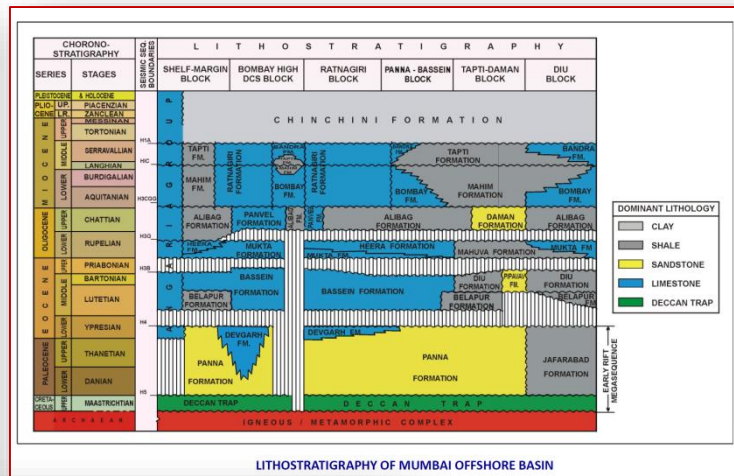
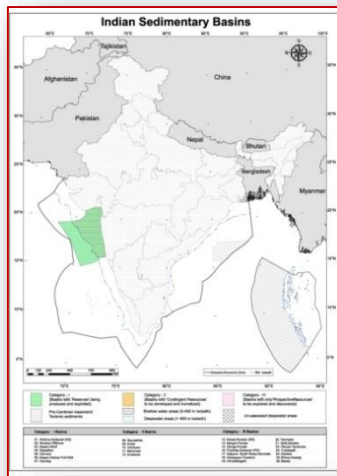
CY-UDWHP-2019/1



CY-UDWHP-2019/1:

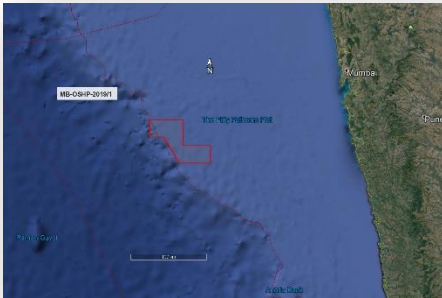
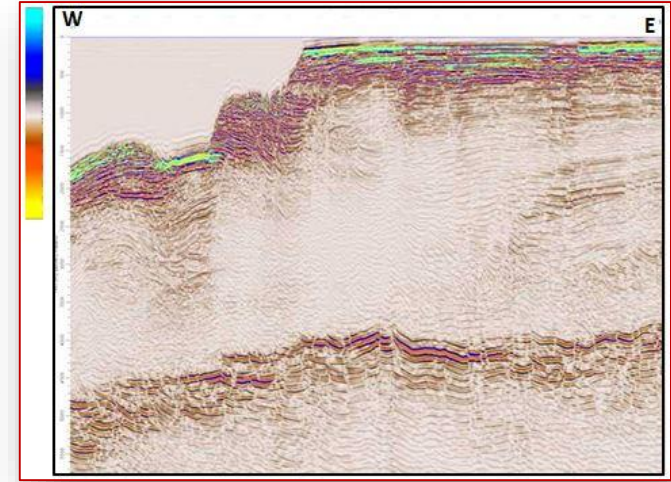
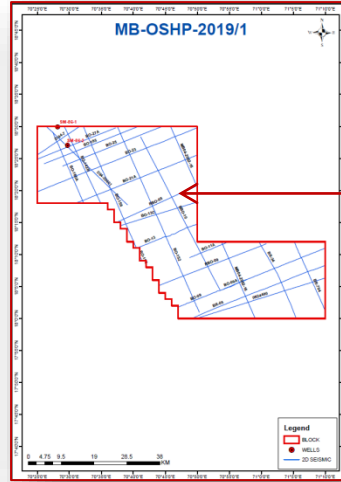
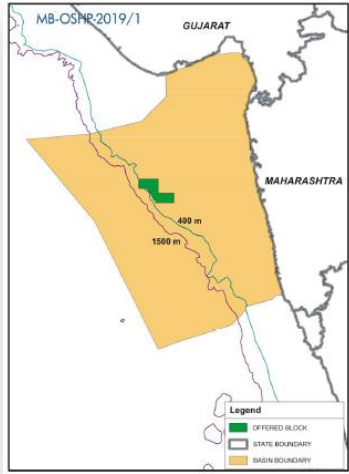
- Located in the area north-eastern extension of Ariyalur-Pondicherry and Tranquebar sub-basins, bounded by the OALP shallow water blocks CY-OSHP-2017/1 and CY-OSHP-2017/2 in the west, the extension of Karaikal High in the south and the ultra-deep area in the east.
- Commercially established reservoirs in the shallow offshore areas are in Basement, Bhuvanagiri and Nannilam Formation. PY-3 field has flowed hydrocarbons from Basement and Nannilam Formation while PY-1 field is primarily producer from Basement. Ganesha field is producer from Bhuvanagiri and Lower Nannilam sands.
- Identified hydrocarbon plays: Synrift/Andimadam, Bhuvanagiri, Nannilam, Kamalapuram and Basement
- Target depth for wells: 3,500 m
- Area: 4064 Sq. Km. | Datasets: 2D seismic, 3D seismic, 4 wells, reports

MUMBAI BASIN



| Prognosticated Resources (In-place MMTOE) | | |
|---|--------------|-------|
| Discovered | Undiscovered | Total |
| 4794 | 4852 | 9646 |
| Total Area (Sq Km) | 212,000 | |

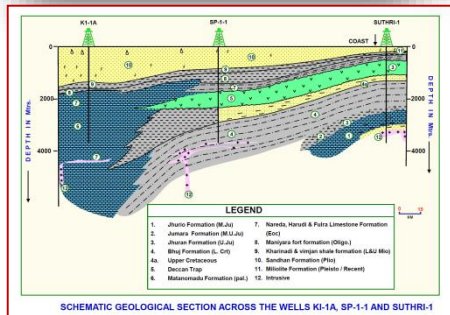
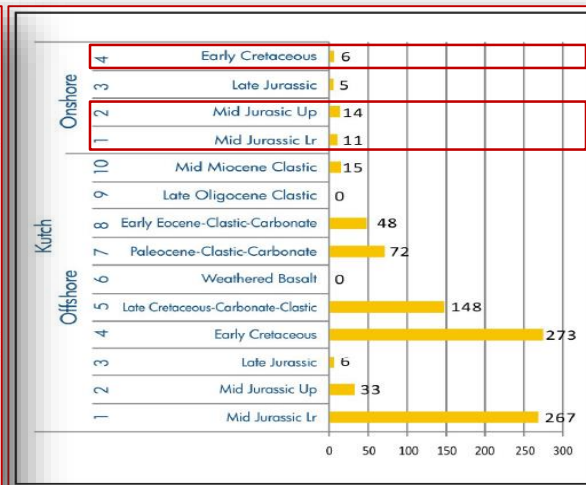
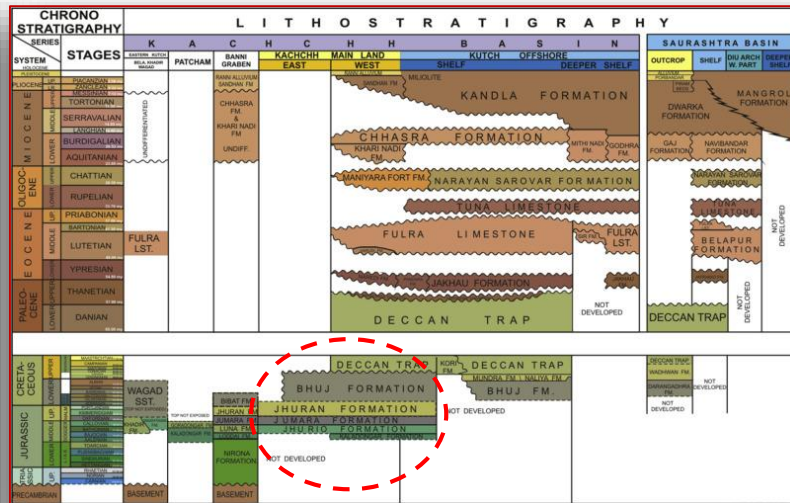
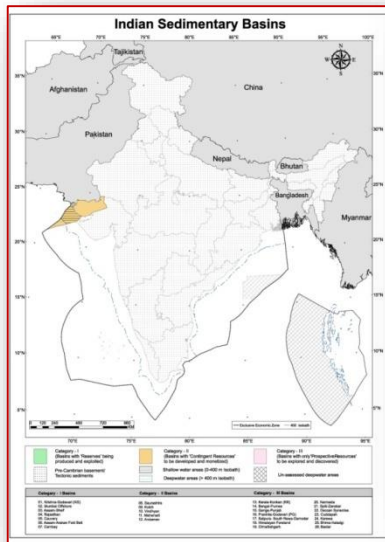
- Block-on-offer: 1
- Cumulative area: 2,247 sq km



MB-OSHP-2019/1:

- ☐ Located in the southern part of shelf margin area towards the east of deepwater Blocks, BB-OS-DW-I & -BB-OS-DW-II and south of the NELP block MB-OSN-2005/3.
- ☐ With 2 gas discoveries in MBS053NAA-1 and MBS053NAG-1 in the southern NELP block, the Pliocene-Pliocene biogenic petroleum system has been established
- ☐ Identified hydrocarbon plays: Paleocene-Eocene Carbonate-Panna, Miocene-Pliocene Biogenic
- ☐ Target depth for wells: 1,050 m
- ☐ Area: 2,247 Sq. Km. | Datasets: 2D seismic, 3D seismic, 2 wells, reports

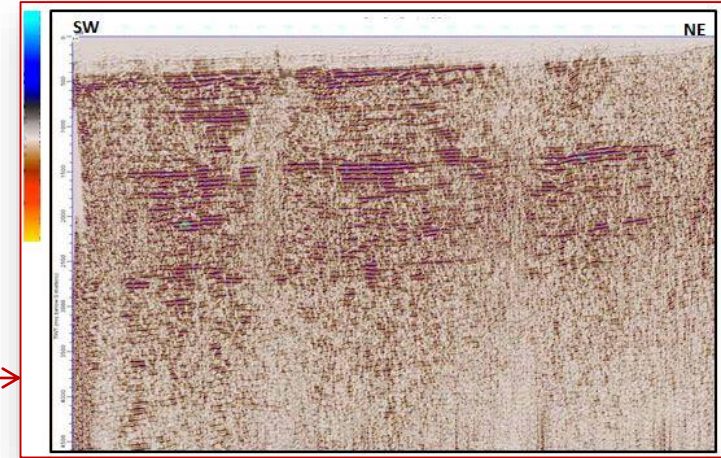
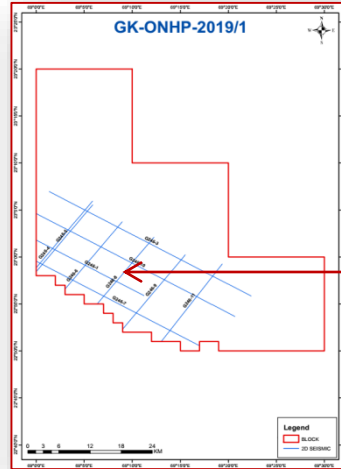
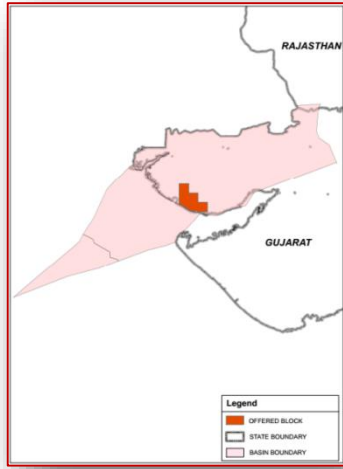
KUTCH BASIN



Prognosticated Resources (In-place MMTOE)

| Discovered | Undiscovered | Total |
|--------------------|--------------|--------|
| 71 | 827 | 898 |
| Total Area (Sq Km) | | 58,554 |

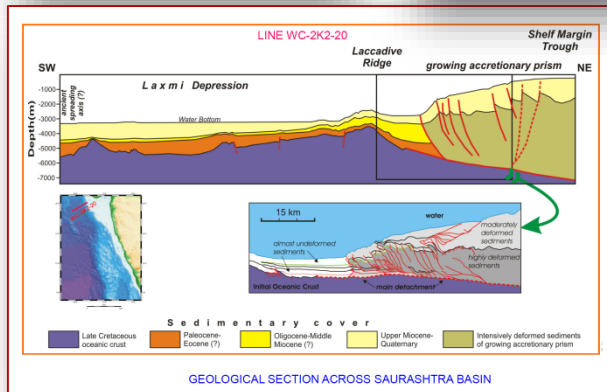
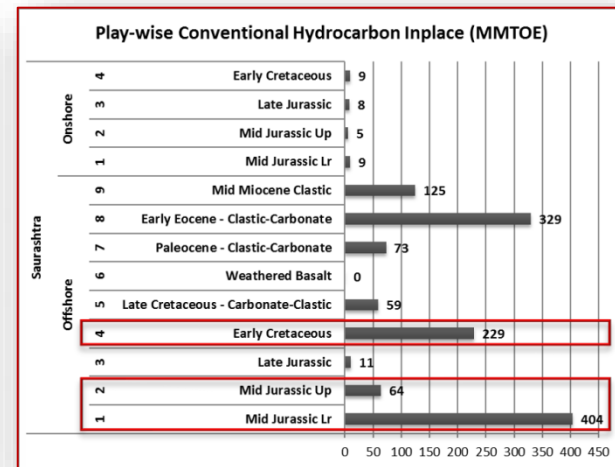
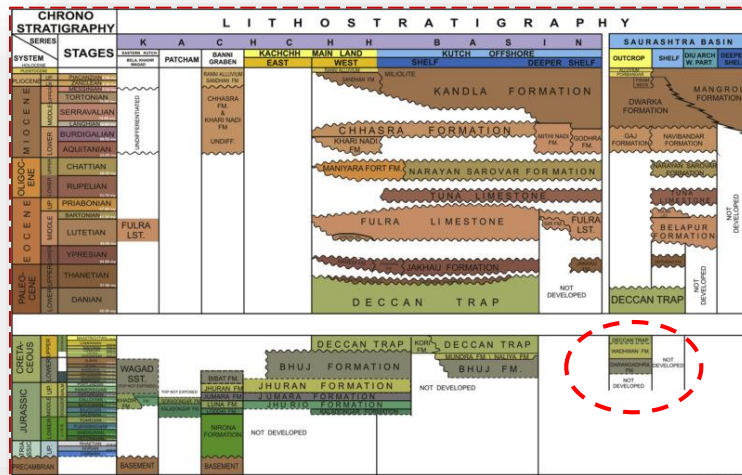
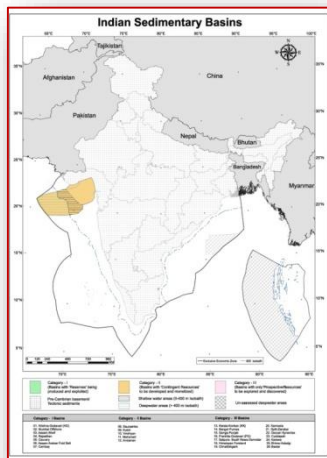
- Block-on-offer: 1
- Cumulative area: 1,693 sq km



GK-ONHP-2019/1:

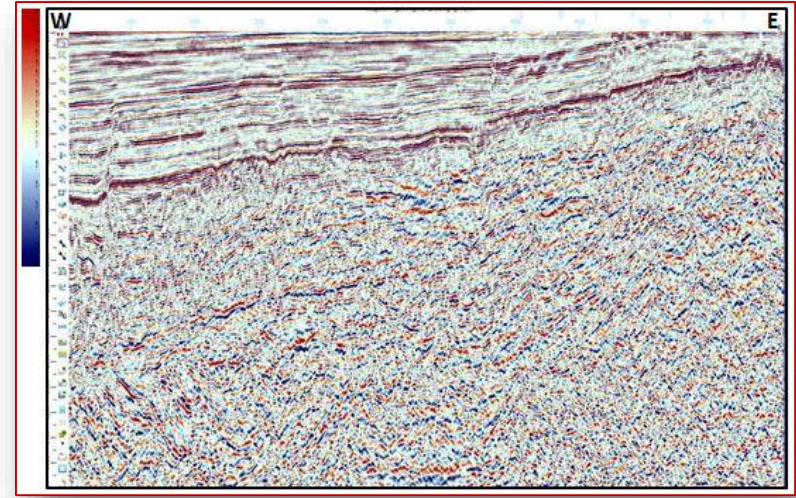
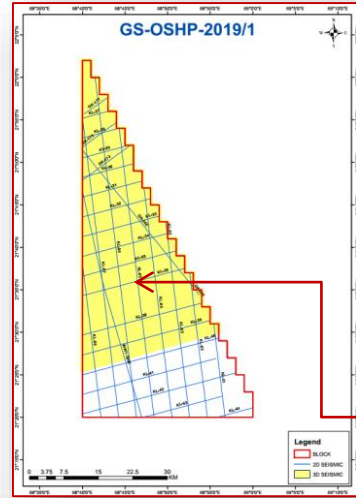
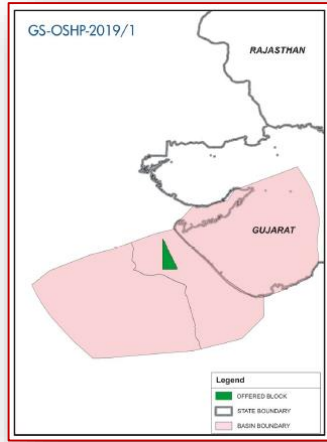
- ☐ Located to the east of OALP block GK-ONHP-2017/1.
- ☐ Minor gas has been reported from well Nanak-G from Jhuran limestone of Mesozoic. The well Lakhpat-1 has flowed gas during testing from Bhuj Formation
- ☐ Identified hydrocarbon plays: Mid Jurassic deltaic play (Jhurio, Jumara and Jhuran Formations) and Early Cretaceous deltaic play (Bhuj Formation)
- ☐ Target depth for wells: 2,300 m
- ☐ Area: 1,693 Sq. Km. | Datasets: 2D seismic

SAURASHTRA BASIN



| Prognosticated Resources (In-place MMTOE) | | |
|---|--------------|-------|
| Discovered | Undiscovered | Total |
| 79 | 1246 | 1325 |
| Total Area (Sq Km) | 194,114 | |

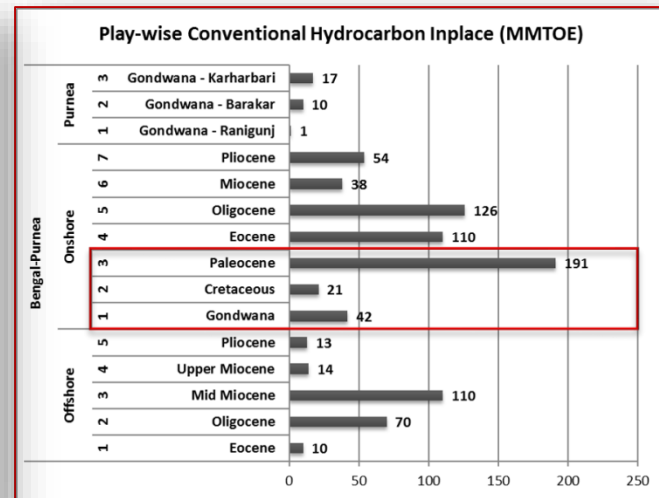
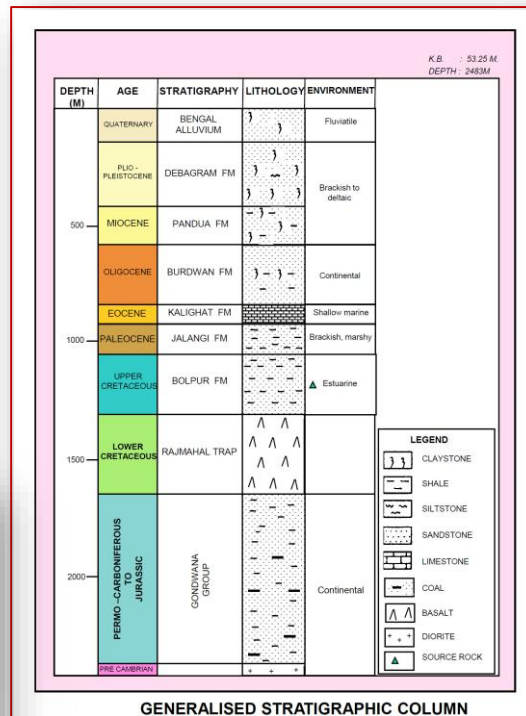
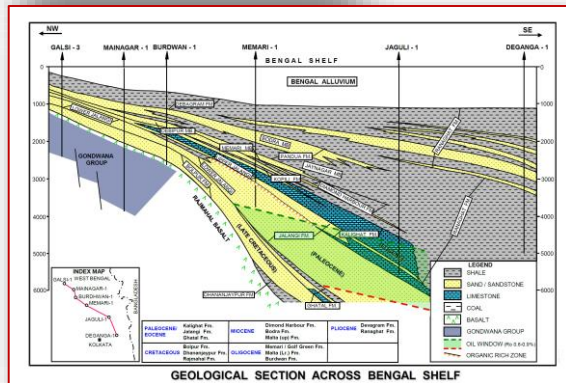
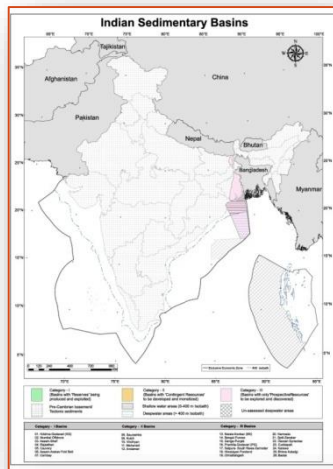
- Block-on-offer: 1
- Cumulative area: 1421 sq km



GS-OSHP-2019/1:

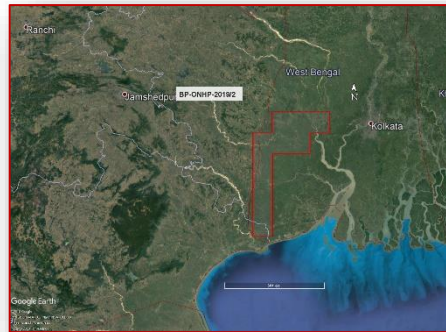
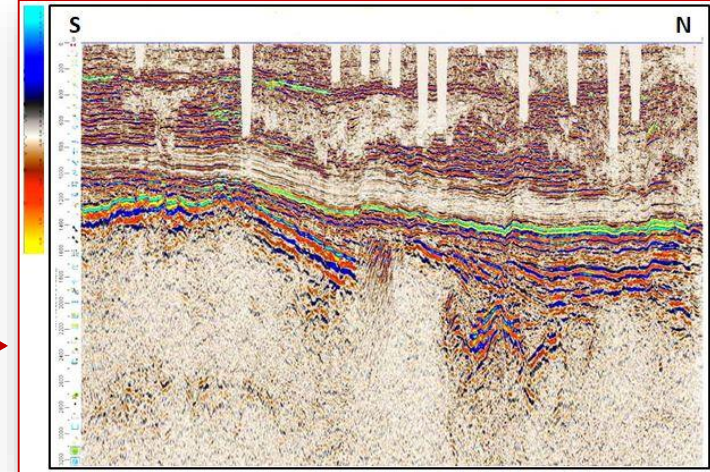
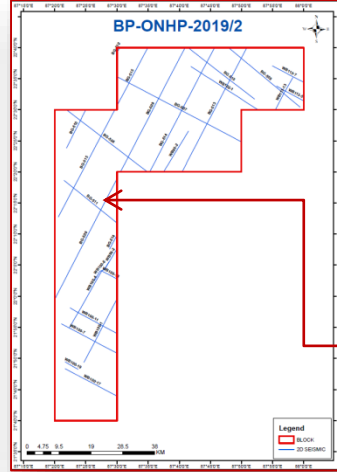
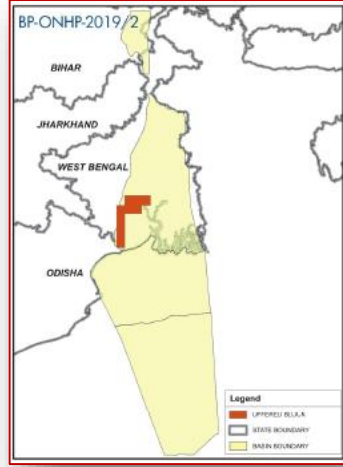
- ☐ Located adjacent to the OALP block GS-OSHP-2017/1 in the east
- ☐ Existence of a Mesozoic-Mesozoic Petroleum System has been established on the basis of the discovery of Jurassic play at well, GSS041NAA-1 and Jurassic/Cretaceous play at GSS041NAA-2.
- ☐ Identified hydrocarbon plays: Jurassic and Cretaceous
- ☐ Target depth for wells: 2,200 m
- ☐ Area: 1,421 Sq. Km.
- ☐ Datasets: 2D seismic, 3D seismic

BENGAL-PURNEA BASIN



| Prognosticated Resources (In-place MMTOE) | | |
|---|--------------|---------|
| Discovered | Undiscovered | Total |
| 0 | 828 | 828 |
| Total Area (Sq Km) | | 121,914 |

- Block-on-offer: 1
- Area: 3,170 sq km



BP-ONHP-2019/2:

- ☐ Located in the north and west of OALP Block BP-ONHP-2019/1 and in south-west of NELP Block WB-ONN-2005/3.
- ☐ Strati-structural plays are present within Paleocene-Late Cretaceous sequences representing channels in low stand stratigraphic framework
- ☐ The area has exploration target primarily in Gondwana along with Paleocene and Cretaceous sequence
- ☐ Target Depth for wells: 2,100 m
- ☐ Area: 3,170 Sq. Km. | Datasets: 2D seismic

Brief of offer under OALP Round V

- Contract blocks-on-offer: 11
- Target basins: 8
- Target Plays: Pre -Cambrian / Paleocene- Eocene/
Cretaceous(Basement)/ Pliocene(Biogenic)
- Prospectivity Level: Category I (8), Category II (2), Category III (1)
- Acreage spread: Onland (8), Shallow Water (2), Ultra Deep Water (1)
- Total area on offer: 19,789 sq. km.
- Individual area size: 19 to 4,064 sq. km.
- Shallowest target depth: 500 m
- Deepest target depth: 4,000 m
- Datasets: Seismic, well logs, well information and reports

Opportunities to OALP bidders

- Contract areas are all pre-assessed by prospective bidders
 - Information on block-level prospectivity outlined by originator through due diligence report
 - **Basin-specific Technical Booklets and the presentation** are available online
- NDR ready with the Data Rooms
 - **Industry-standard G&G interpretation software** with full functionality are available for on-the-spot assessment
- Continued access to NDR for more strength/missed-out data
 - NDR is updated with new data including recently acquired seismic 2D data from NSP (“National Seismic Programme”)
 - **Basin-specific information on hydrocarbon resources are available**
- NCR (“National Core Repository”) has been conceptualized
 - **However Cores/ Drill-cuttings/ Fluid samples** can be accessible from NOC’s Core Labs, declared as National Assets



*Welcome to an opportunity ..
of exploring the 'undiscovered' potential of both
conventional and un-conventional hydrocarbons, under
leveraged fiscal terms and simplified contracts...*

