



# Overview of Indian Sedimentary Basins and Blocks-on-Offer (under OALP Bid Round III)



### Presentation outline

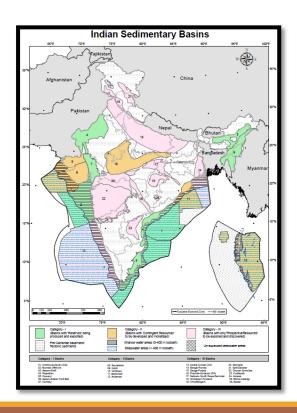
- Indian Sedimentary Basins
- Hydrocarbon Resources Reassessment Study
- Contract Areas-on-Offer
- Basin-wise Brief of Contract Areas
- ☐ Summary



### **INDIAN SEDIMENTARY BASINS**



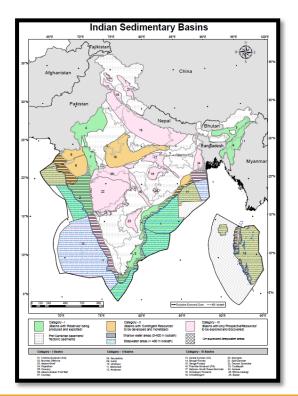
# Basin category

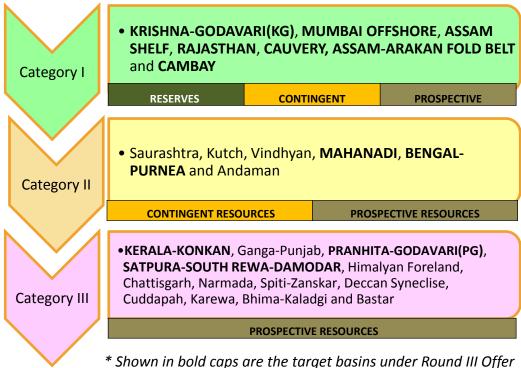


- A new 3-tier category for 26 basins
- A simplified approach to present the Category based on the maturity of resources in line with PRMS standard
- Category I: 7 basins which are commercially producing from established petroleum resources ("RESERVES")
- Category II: 5 basins which have established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



# Basins under category







# HYDROCARBON RESOURCES 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
- Assessed 13 basins with adequate datasets 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
- Identified a total of 177 Plays
  - 87 in Tertiary, 53 in Mesozoic and 37 Pre-Mesozoic
- Indentified new plays
  - 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 easy-to-use subsurface models, maps and reports



# Results compared

#### 1995-96 study

☐ Simplistic tools and limited datasets
☐ Areal Yield (AY) method used for all basins

Carried out for 15 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

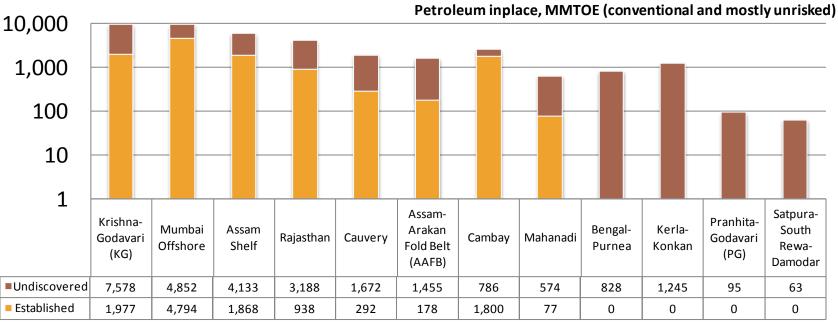


### **CONTRACT AREAS-ON-OFFER**



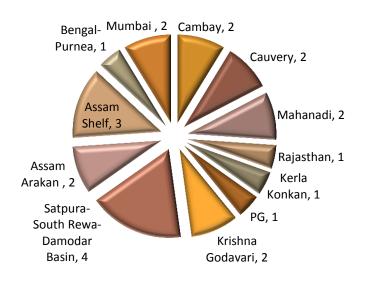
# Basin-wise Hydrocarbon Resources

(Target Basins under Bid Round III)





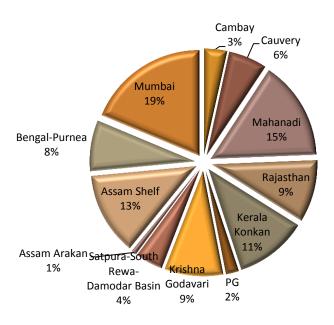
### **OALP Blocks across Basins**



- ☐ Total 23 blocks on offer including 5 CBM
  - Distributed into 12 sedimentary basins
- ☐ Satpura-South Rewa-Damodar Basin has most number of blocks (4)- all CBM
- ☐ 14 blocks from Category I basins
- 3 blocks from Category II
- 6 blocks from Category III



### Basin Area across Blocks



- ☐ Total area 31,722 sq km
- Mumbai, Mahanadi, Assam Shelf and Kerala-Konkan have maximum acreage
- ☐ 14 blocks in Onland

(17,818 sq km, 56% of total offering)

- 3 in Shallow-water
  - (9,456 sq km, 30%)
- ☐ 1 block in Deepwater
  - (2,491 sq km, 8%)
- ☐ 5 block under CBM

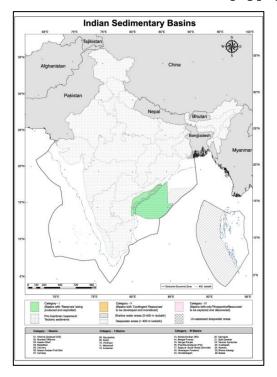
(1,957 sq km, 6%)



#### BASIN-WISE BRIEF OF CONTRACT AREAS



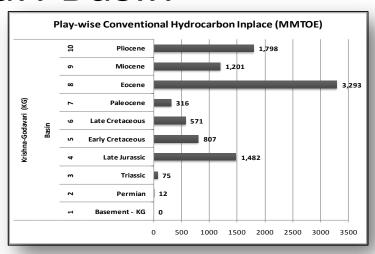
### Krishna-Godavari Basin





KG-ONHP-2018/1

KG-ONHP-2018/2

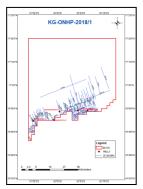






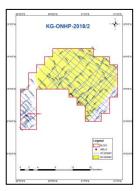
### Krishna-Godavari Basin

#### KG-ONHP-2018/1



- ☐ Commercial hydrocarbon accumulations in Archean fractured basement and synrift Gollapalli sandstone are established.
- Endamuru, Kommugudem, Draksharama, Dangeru and Mandapeta areas have reported major discoveries in multiple pays.
- ☐ Target Depth: 2,000 m.
- Approximate Area 2,601 Sq. Km.
- ☐ Datasets: 2D Seismic, 5 Wells, 10 Reports

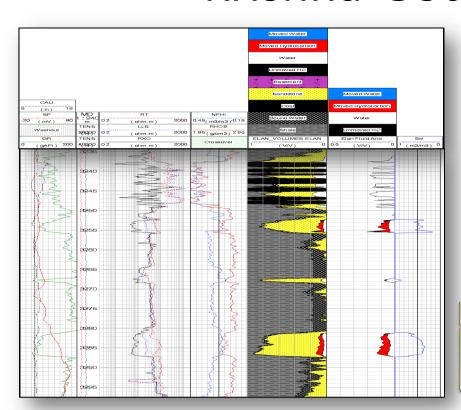
KG-ONHP-2018/2



- Located on the flanks of Kaza tectonic high.
- ☐ Rift-fill sequence of Nikkamaru area and gas producing sequence in Nandigama are expected.
- Jurassic-to- Early Cretaceous (Gollapalli) and Cretaceous-L.
   Cretaceous (Raghavapuram) plays are envisaged in this block.
- ☐ Target Depth: 4,000 m.
- ☐ Approximate Area 230 Sq. Km.
- ☐ Datasets: 2D Seismic, 3D Seismic, 1 Well, 2 Reports



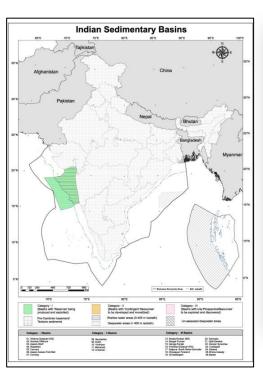
### Krishna-Godavari Basin

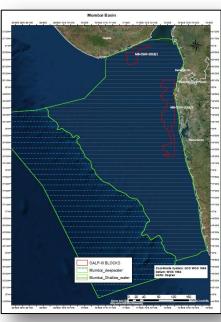


- · KG Onland Paleozoic
- Gas @ 25k+ SCMD
- · Choke: 16/64"
- Formation: Kommugudem (Permo-Triassic)
- Depth: ~3,300m



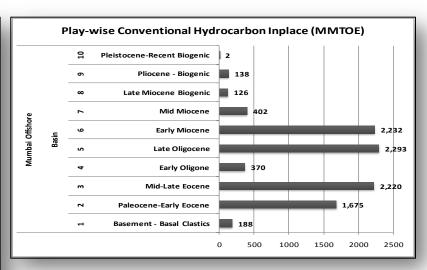
### Mumbai Offshore Basin





MB-OSHP-2018/1

MB-OSHP-2018/2





➤ Blocks-on-offer: 2

Cumulative area: 5,936 sq km



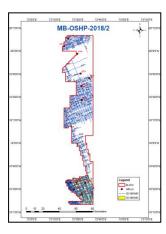
### Mumbai Offshore Basin

#### MB-OSHP-2018/1



- ☐ Hydrocarbons are established in Mahim, Daman and Mahuva formations in C-37, NMT, Mid Tapti and Ambe fields.
- Prospects in Panna, Diu, Mahuva and Mahim formations.
- ☐ Target Depth: 1,400 m
- ☐ Approximate Area 1,268 Sq. Km.
- ☐ Datasets: 2D Seismic, 3D seismic, 8 Wells, 14 Reports.

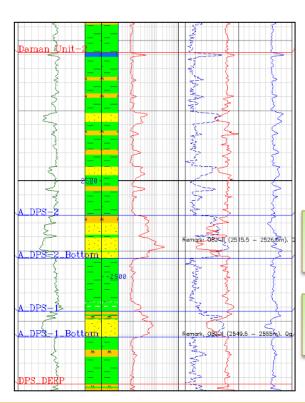
#### MB-OSHP-2018/2



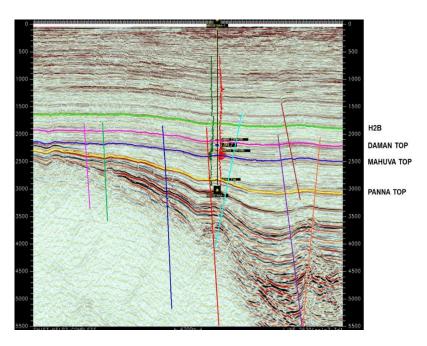
- Hydrocarbons are established in B-170, B-66, South Bassein, North Heera and Heera fields.
- Prospects in Panna and Bassein Formation. Hydrocarbon indications are reported from Alibag and Bombay formations.
- ☐ Target Depth: 1,200 m (1600-2200-DDR)
- ☐ Approximate Area 4,668 Sq. Km.
- Datasets: 2D Seismic, 3D seismic, 12 Wells, 21 Reports.



### Mumbai Offshore Basin

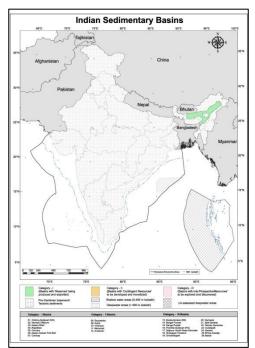


- · Discovery in Daman
- Gas @ 32 k m3/d (Choke: 1/2")
- Formation: Daman (U. Oligocene)
- Depth: ~2515-2526m
- · Discovery in Daman
- Gas @ 42 k m3/d (Choke: 1/2")
- Formation: Daman (U. Oligocene)
- Depth: ~2549-2555m



Recent Discovery in Daman-Diu



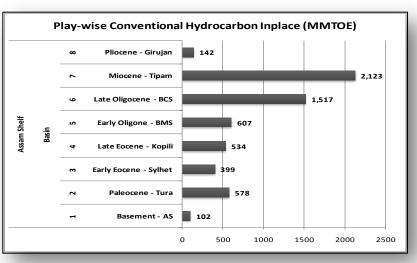




AA-ONHP-2018/1

AA-ONHP-2018/2

AA-ONHP-2018/3



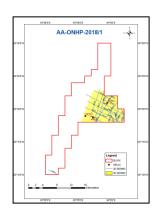


Blocks-on-offer: 3

Cumulative area: 4,010 sq km

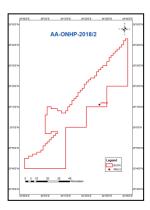


#### AA-ONHP-2018/1



- Hydrocarbons are established from areas of Lakhibari East, Hazarigaon, Kalanpur and Suphyam (Bokabil formation).
- ☐ Potential exists within Tura, Sylhet, Kopili and Barail, including Gondwana rift fill sequences.
- Target Depth: 1,500 m.
- Approximate Area 249 Sq. Km.
- ☐ Datasets: 2 D Seismic, 3D Seismic, 3 Wells, 3 reports.

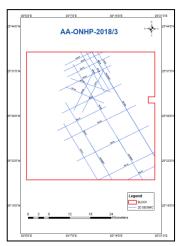
#### AA-ONHP-2018/2



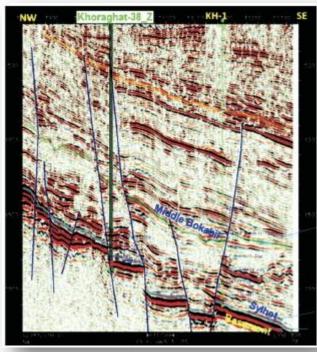
- Located over thrust-related anticlines in the Naga-Schuppen belt, well known for hydrocarbon sources.
- Hydrocarbon potential exists within Eocene-Paleocene Formation.
- ☐ Target Depth: 1,500 m.
- ☐ Approximate Area 2,527 Sq. Km.
- □ Datasets: No Seismic data (adjacent 2D seismic data of Hakejanaga- Chumuked area), 1 Well, 2 Reports.



#### AA-ONHP-2018/3

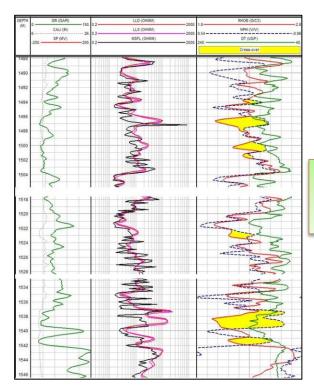


- ☐ Located in similar geologic/geological set-up with nearby fields like Khoraghat and Nambar.
- Hydrocarbon potential exists within Palaeocene-to-Lower Eocene section (Tura/Sylhet) and Oligocene (Barail).
- ☐ Target Depth: 2,000 m.
- ☐ Approximate Area 1,234 Sq. Km.
- ☐ Datasets: 2D Seismic, (adjacent well data of TNPH-1, RJPH-1).

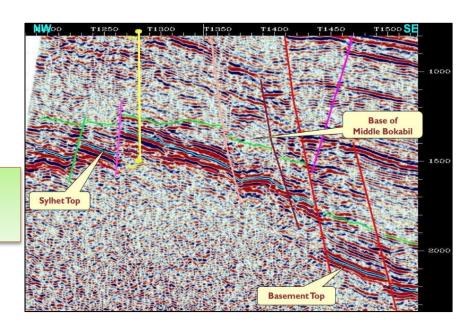


Recent Discovery Khoraghat





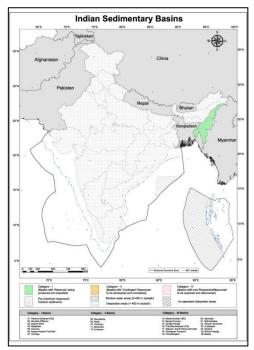
- Discovery in Basal Sandstone & Sylhet
- Flowed Gas
- Depth-1493-1542



Discovery in Hazarigaon



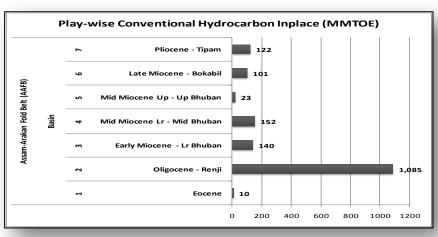
### Assam-Arakan Fold Belt Basin





AA-ONHP-2018/5

**AA-ONHP-2018/4** 



	Prognosticated Resources (In-place MMTOE)	
Discovered	Undiscovered	Total
178	1,455	1,633

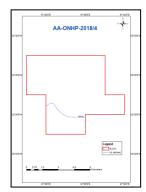
➤ Blocks-on-offer: 2

Cumulative area: 252 sq km



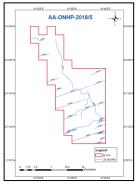
### Assam-Arakan Fold Belt Basin

#### AA-ONHP-2018/4



- The region has established petroleum system with likely gaseous hydrocarbon over oil.
- Prospectivity is identified in Bokabil, Upper Bhuban, Middle Bhuban and Miocene of Surma Group, with Jenam-Bhuban-Bokabil petroleum system.
- Target Depth: 3,000 m.
- Approximate Area 44 Sq. Km.
- Datasets: 2D Seismic, (adjacent well data of GJLA-10, 11, 12, 13)

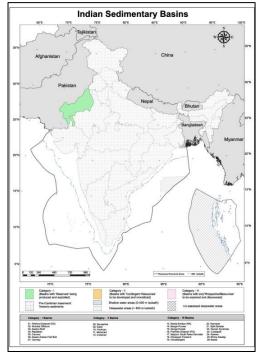
#### AA-ONHP-2018/5



- The region has established petroleum system with likely gaseous hydrocarbon over oil.
- Prospectivity lies within Bokabil, Upper Bhuban, multistacked sandstones of Middle Bhuban, all confined into Oligocene –to-Middle Miocene sequences.
- ☐ Target Depth: 2,500 m.
- ☐ Approximate Area 208 Sq. Km.
- Datasets: 2D Seismic, (adjacent well data of GJLA-10, 11, 12, 13)

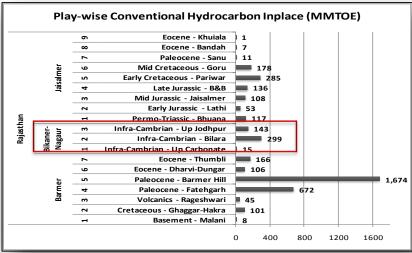


# Rajasthan(Bikaner-Nagaur Sub-basin)





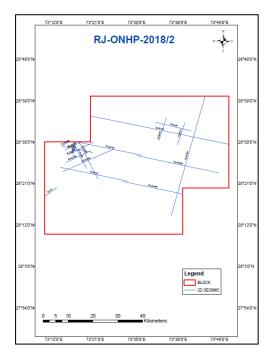
**RJ-ONHP-2018/2** 





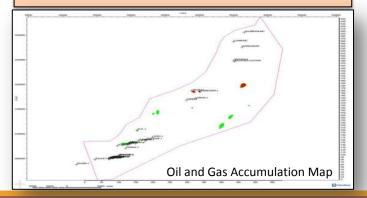


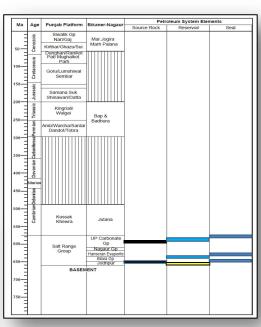
# Rajasthan (Bikaner-Nagaur Sub-basin)



#### **RJ-ONHP-2018/2**

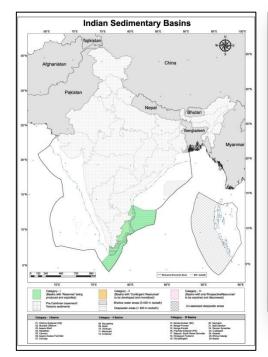
- Prospectivity lies in Jodhpur Formation and Shallower Upper Carbonate Formation
- ☐ Jodhpur Formation has established hydrocarbon (Baghewala heavy oil discovery)
- Target Depth: 900 m.
- Approximate Area 3,016 Sq. Km.
- Datasets: 2D Seismic, No wells (adjacent wells of Baghewala, Nanuwala)







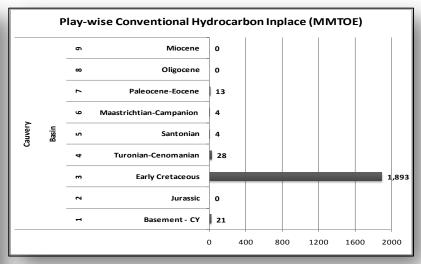
# Cauvery Basin





CY-ONHP-2018/2

CY-ONHP-2018/3





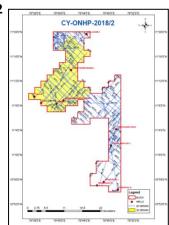
➤ Blocks-on-offer: 2

Cumulative area: 1,863 sq km



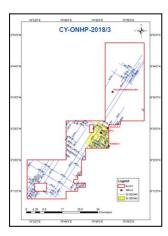
# Cauvery Basin

#### CY-ONHP-2018/2



- Commercial hydrocarbons are established in fractured gneissic basement in Madanam and Pandanallur.
- Potential in Basement play and Nannilam sands.
- ☐ Target Depth: 3,000 m.
- Approximate Area 460 Sq. Km.
- Datasets: 3D Seismic, 2D Seismic, 11 Wells, 18 Reports.

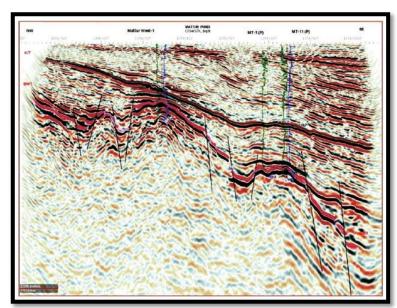
#### CY-ONHP-2018/3



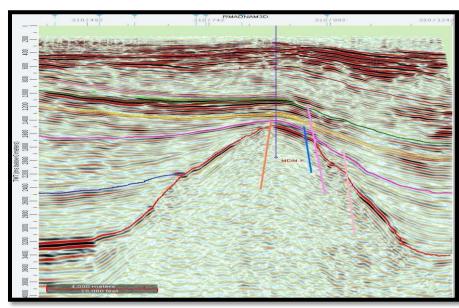
- Significant production is achieved in Ramnad sub-basin from the Nannilam and Bhuvanagiri formations.
- Potential in Andimadam, Bhuvanagiri and Nannilam formations.
- ☐ Target Depth: 1,800 m.
- ☐ Approximate Area 1,403 Sq. Km.
- □ Datasets: 2D Seismic, 3D Seismic, 5 Wells, 10 Reports.



# Cauvery Basin



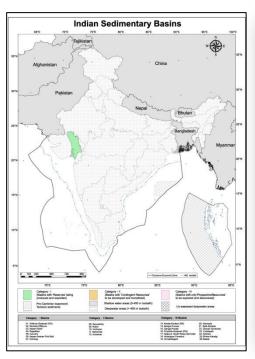
Discovery Mattur West-1 in Cauvery Basin



- Discovery in Madnam
- Gas @ 40k+ SCMD (Choke: 5mm)
- Formation: Kamalapuram (Eocene)
- Depth: ~1,500m



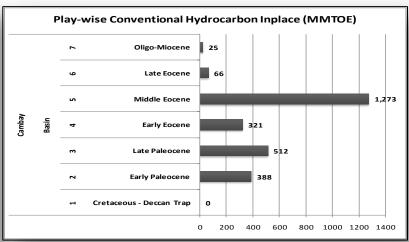
# Cambay Basin





CB-ONHP-2018/3

CB-ONHP-2018/4



### Prognosticated Resources (In-place MMTOE)

Discovered	Undiscovered	Total
1,800	786	2,586

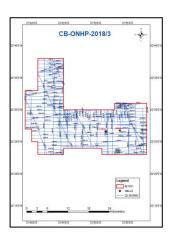
➤ Blocks-on-offer: 2

Cumulative area: 1,078 sq km



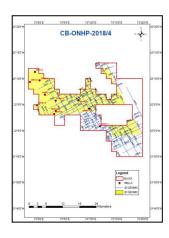
# Cambay Basin

#### CB-ONHP-2018/3



- Situated in northeast of Cambay field in Tarapur block.
- Multiple leads identified at Kalol and Cambay shale level.
- Target Depth : 1,500m.
- Approximate Area: 519 Sq. Km.
- 2D seismic, 2 wells, 4 Reports

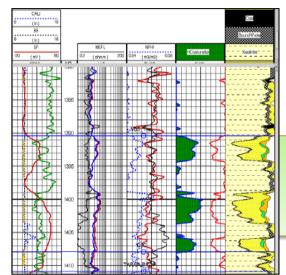
CB-ONHP-2018/4



- Situated in south of Padra field in eastern basin margin.
- Multiple leads identified at Kalol and Basement level.
- Target Depth : 1,000m.
- Approximate Area: 559 Sq. Km.
- 2D and 3D seismic, 11 wells, 20 reports

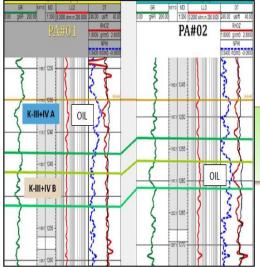


Cambay Basin



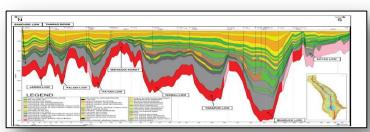
#### **Miocene Basal Sands (MBS)**

- Oil discovery
- Oil @ 200+ BOPD, 5mm bean
- Southern part (Akholjuni area)
- Depth: ~1,450m



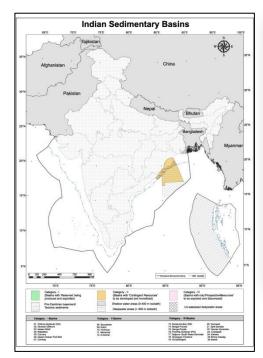
#### K-III/K-IV

- · Oil discovery
- Oil @ 25+ BOPD, 12/64" bean
- Eastern margin (Dehgam area)
- Depth: ~1,250m





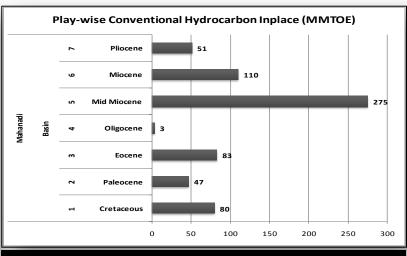
### Mahanadi Basin





MN-DWHP-2018/1

MN-ONHP-2018/5





Discovered Undiscovered Total 77 574 651

- Blocks-on-offer: 2
- > Area: 4,791 sq km



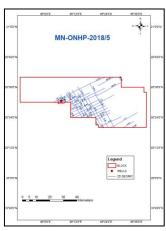
### Mahanadi Basin

#### MN-DWHP-2018/1



- ☐ Gas discoveries were made in the surrounding blocks in shallow and deepwater (MN-OSN 2000/2 and MN-DWN-98/3).
- ☐ 4 plays identified one structural (Pliocene rollover anticline) and the rest stratigraphic (Mio-Pliocene channels/ slope fans).
- Target Depth for wells: 2,750m.
- ☐ Approximate Area: 2,491 Sq. Km.
- □ 2D/3D seismic data, 11 wells, 23 reports.

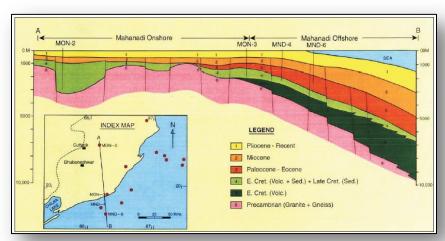
#### MN-ONHP-2018/5



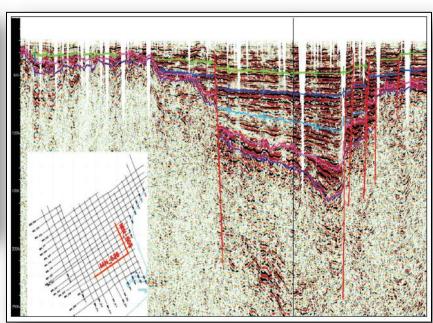
- Surrounded by OALP-II blocks-on-offer.
- Prospectivity inferred from drilled well, MON-2 which established rich source rock potential of Early Cretaceous age.
- ☐ Target Depth for wells: 2,500m.
- ☐ Approximate Area: 2,300 Sq. Km.
- ☐ 2D seismic data, 1 well and 1 Report.



## Mahanadi Basin



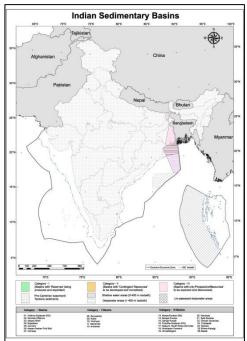
Schematic geological section across Mahanadi Basin



2D seismic sections from recently acquired data of NSP

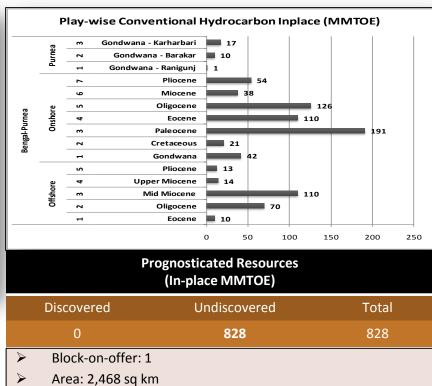


# Bengal-Purnea Basin



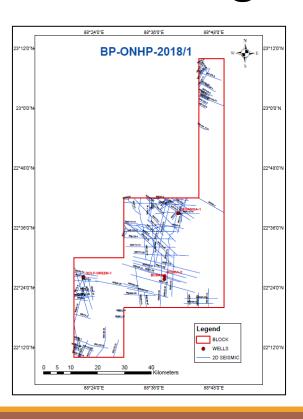


**BP-ONHP-2018/1** 





## Bengal-Purnea Basin

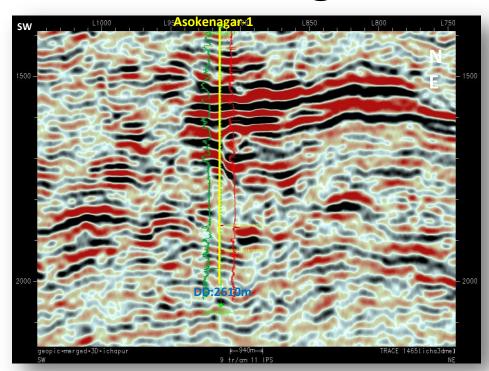


#### **BP-ONHP-2018/1**

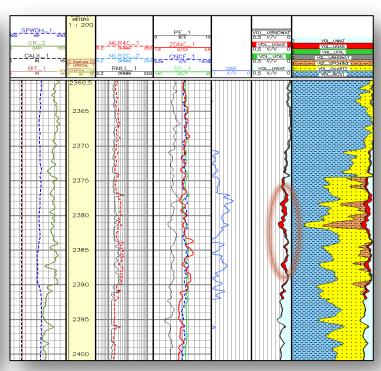
- □ Located over similar petroleum habitat of the recent oil and gas discovery well, Ashoknagar-1 (NELP Block WB-ONN-2005/4)
- ☐ Inferred the presence of Mio-Pliocene channel-leveecomplex with thermogenic hydrocarbon, charged from underlying Paleogene source rocks
- 2 plays are identified: 'Thermogenic' hydrocarbon in Lower Pliocene-Miocene sequence and 'Biogenic' from Upper Pliocene sequence
- ☐ Target Depth for wells: 2,500m
- ☐ Approximate Area: 2,468 Sq. Km.
- ☐ Datasets: 2D seismic, 4 wells and 6 reports



# Bengal-Purnea Basin



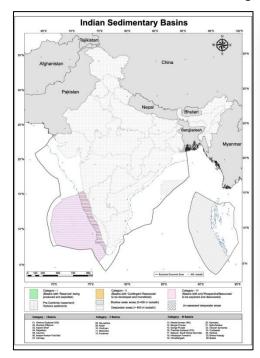
Recent discovery at well, Ashokenagar-1 in onland part of Bengal-Purnea Basin



- Notified gas discovery in Upper Miocene Object-I (2,377-88m)
- Flowed gas 73k SCMD through 6 mm bean

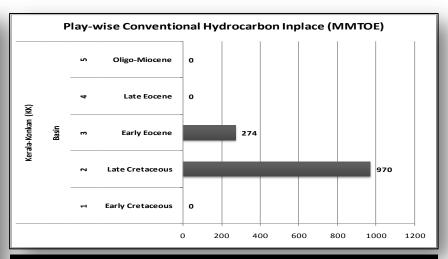


### Kerala-Konkan Basin





KK-OSHP-2018/1

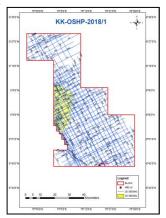




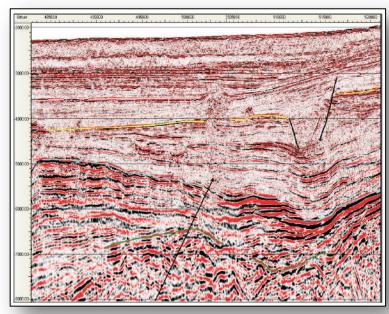


## Kerala-Konkan Basin

#### KK-OSHP-2018/1



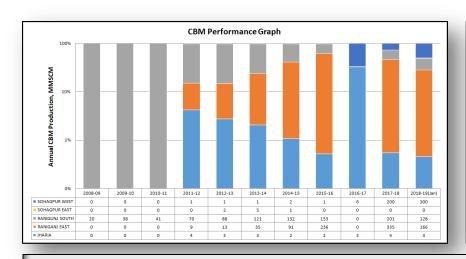
- Prospective petroleum systems are identified in Mesozoic-Mesozoic, Mesozoic-Tertiary and Tertiary-Tertiary.
- Target Depth for wells: 2,000m.
- ☐ Approximate Area: 3,520 Sq. Km.
- ☐ Datasets: 2D/3D seismic.

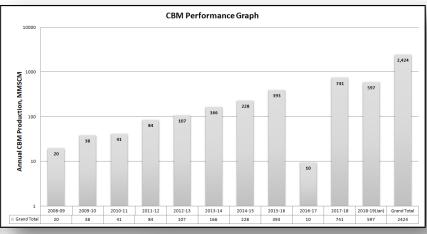


West-East seismic section in Kerala-Konkan Area



# **CBM Operation and Production**



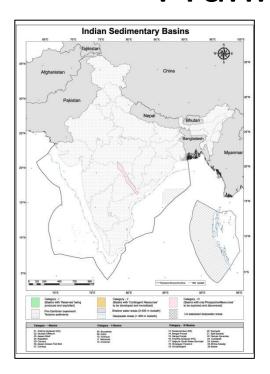


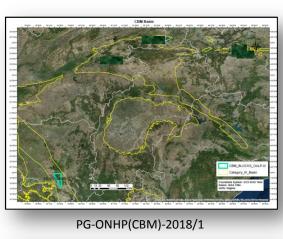
- Globally, India has 4<sup>th</sup> largest coal reserves. CBM resources of 2,600 BCM
- CBM activity is covered under Oil Fields Regulation & Development Act (1948), P&NG Rules (1959) and CBM Policy(1997)
- 33 blocks were awarded in 4 rounds for 63% of 26,000 sq km available coal-bearing acreage across 11 states with prognosticated resources of 1,800 BCM, of which established is 281 BCM
- Production from 5 blocks, Ranigunj(South & East), Sohagpur(West & East), Jharia

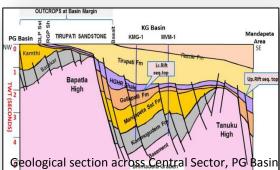
CBM Production Performanace for the month of Jan.'19					
Block	Area (Sq Km)	Gas (MMSCM)	Flowing Wells	Nature of Flow	
JHARIA	85	0.45	7	Artificial Lift	
RANIGANJ EAST	500	17.49	150	Artificial Lift	
RANIGUNJ SOUTH	210	13.28	103	Self flow by 12	
				wells and 91 wells	
				are on artificial lift	
SOHAGPUR EAST	495	0	5	Self Flow	
SOHAGPUR WEST	500	30.92	220	Self Flow	
All Blocks	1,790	62.15	485		

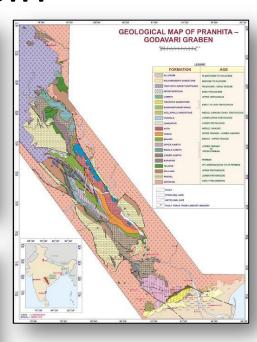


## Pranhita-Godavari Basin







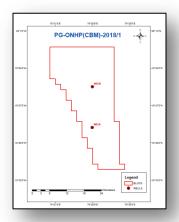


- ➤ Block-on-offer: 1
- Cumulative area: 625 skm



### Pranhita-Godavari Basin

#### PG-ONHP(CBM)-2018/1

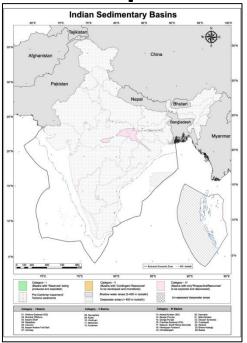


- ☐ The carved-out block is located in the eastern part of Wardha Valley Coal Field.
- ☐ The block has logistic advantage due to well-developed infrastructure facility and proximity to power plants.
- ☐ Barakar Formation (Lower Permian) is the coal-bearing unit, containing one thick composite coal horizon.
- ☐ Target Depth: 1,200m.
- ☐ Approximate Area 625 Sq. Km.
- ☐ Datasets: 2 wells, 1 report.

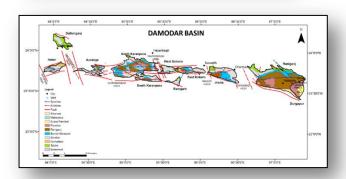
AGE	FORMATION	FILHOFORA	MAXIMUM THICKNESS (m)
UP.CRETACEOUS TO ECCENE	DECCAN TRAP	Y Y Y Y	100
CRETACEOUS	LAMETA	***************************************	50
UPPER TRIASSIC	MALERI		100
O'Though his work			later and the second
UPPER PERMIAN TO LOWER TRIASSIC	КАМТНІ	= = =	800
TO COMER TRANSIN			
			FR   11 - 11 - 11
			and the second
MIDDLE PERMIAN	MOTUR		300
2000	No. Or an age		
LOWER PERMIAN	BARAKAR		
LOWER PERMIAN	BARARAK	michael Leissins	400
UPPER CARBONIFEROUS TO	TALCHIR	TATION TO SE	200
Total Tanman			1
PROTEROZOIC	VINDHYAN		NOT ESTIMATED
ARCHAEAN	METAMORPHICS	the state of the s	



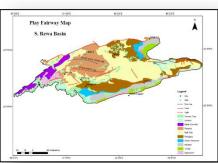
## Satpura-South Rewa-Damodar Basin

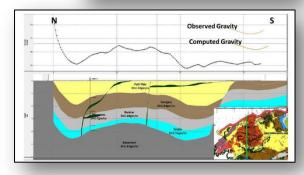






DR-ONHP(CBM)-2018/1 DR-ONHP(CBM)-2018/2 SR-ONHP(CBM)-2018/1 SR-ONHP(CBM)-2018/2



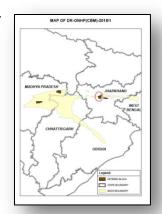


- Blocks-on-offer: 4
- Cumulative area: 1,332 sq km



# Satpura-South Rewa-Damodar Basin

#### DR-ONHP(CBM)-2018/1



- ☐ The carved-out block is in the north-northeastern part of North Karanpura coalfield of the Damodar Valley, Jharkhand.
- Lower Permian Barakar Formation is the coal bearing unit and crop out in the peripheral region of the ovate coalfield.
- Depth range: 0 to 300+ m.
- ☐ Approximate Area 348 Sq. Km.
- ☐ Datasets: 8 Wells, 1 Report

#### DR-ONHP(CBM)-2018/2



- The carved-out block lies in the southern part of South Karanpura Coalfield.
- ☐ Barakar Formation (L. Permian) is the coal bearing unit.
- Depth range: 0 to 480 m.
- Approximate Area 138 Sq. Km.
- ☐ Datasets: 13 Wells, 4 Reports



# Satpura-South Rewa-Damodar Basin

#### SR-ONHP(CBM)-2018/1



- ☐ The carved-out block is located in the Singrauli Main Basin which is an part of South Rewa Basin containing Sohagpur-Johilla coalfields.
- Coal seams are confined to the upper part of the middle member of Barakar formation.
- ☐ Depth range: 300-800 m.
- Approximate Area 400 Sq. Km.
- ☐ Datasets: 2D Seismic (184 LKM), 8 Wells, 9 Reports.

#### SR-ONHP(CBM)-2018/2



- The carved-out block is located in the central part of the Johilla coalfield in Shahdol district of MP.
- Lower Gondwana rocks of Talchir, Barakars and beds of Ranigani are well-developed.
- ☐ Depth range: 0-1,200m.
- ☐ Approximate Area 446 Sq. Km.
- □ Datasets: 2D Seismic (16 LKM), 1 Well, 1 Report.



### Brief of contract areas

Contract blocks-on-offer:
 23 Blocks (18 conventional + 5 CBM)

Target basins:
 12 including 2 for CBM only

Prospectivity level: Category I (14), Category II (3), Category III (6)

Acreage spread:
 Onland 19 + Shallow water 3 + Deepwater 1

- Total area on offer: 31,722 sq km (including 1,957 sq km of CBM Area)

Individual area size:
 44 to 4,668 sq km (CBM-138 to 625 sq km)

Shallowest target depth:
 900 m (Conventional only)

Deepest target depth: 4,000 m (CBM-1200m)

Datasets: Seismic, wells, reports including HC resources study



## Opportunities to OALP bidders

- Contract areas are largely pre-assessed by prospective bidders
  - Information on block-level prospectivity outlined by originator through due diligence report
  - Basin-specific Technical Booklets are available online for constituent contract areas
- NDR has already set up the data rooms
  - Industry-standard interpretation software with full G&G functionality are available for basic interpretation
- Continued chance of access to NDR for more/missed-out data
  - NDR is updated with new data continuously
  - Basin-specific information on hydrocarbon resources are now available
- NCR ("National Core Repository") is now conceptualized on a global industry standard
  - Access to Cores/ Drill-cuttings/ Fluid samples is however available from across basins from NOC's Core Labs, now declared National Asset





Welcome to an opportunity .. of exploring the 'undiscovered' potential of both conventional and un-conventional hydrocarbons, under two contract formats.. Leveraging fiscal benefits and contractual simplicity..

