

**HELP, the regime of new oil in India: A case study of Andaman Fore Arc**

By: Shri A.Borthakur\* , Ms.Shilpi Gupta, Shri J. Tikku

Email: *borthakur\_atul@ongc.co.in***Keywords**

HELP, Andaman Fore Arc, Exploration

**Summary:**

Government of India has announced the Hydrocarbon Exploration Licensing Policy (HELP) to incentivize exploration for enhancing domestic hydrocarbon production in Indian Sedimentary Basin. This policy is based on a revenue sharing fiscal model. In the HELP regime, Government of India is giving dispensation in royalty. The bidding of acreages will be under the provisions of Open Acreage Licensing Policy (OALP). Investors can carve out their own blocks for all types of hydrocarbon and submit Expression of Interest (EoI).

In present context, G & G data of Andaman Fore Arc area has been analyzed to explore this area under the provision of OALP. The Fore Arc setup has witnessed gas discovery both at Miocene and Pliocene levels. Gas is also evident at Late Cretaceous to Eocene level. A case study has been taken up for study and priority area identified. In this regard, the setup have been correlated with nearby analogous basin too and inferences corroborated. The approach may lead to mark Andaman in oil map of India.

**Introduction:**

Economic growth of any country is a dynamic process, more so for the oil and gas sector. To step up the level of investment, Government of India keeps on working on uniformity of policies for encouraging investment. The Hydrocarbon Exploration Licensing Policy (HELP), based on a revenue sharing fiscal model, has been notified by the Government of India on 10.03.2016 as a successor to existing New Exploration Licensing Policy (NELP). The objective of the HELP policy is to enhance domestic hydrocarbon production by aggressive exploratory effort in Indian Sedimentary Basin. In present deliberation the feasibility study is carried out for bidding an acreage of Andaman Fore Arc area under Open Acreage Licensing Program (OALP).

The Andaman basin covering an area more than of 50,000 sq km consists of various tectonic setting, i.e. Trench slope break/accretionary prism, Fore Arc, Volcanic Arc and Back Arc. From Myanmar to

Sumatra, the basin is witnessed by oblique convergent plate boundaries of Indian Oceanic and SE Asian Oceanic plates commenced in Cretaceous time. The Island system of the basin follows parallel to Sunda subduction zone from Great Nicobar to Great Coco Island. The hydrocarbon resources in the basin have been estimated in the order of 180 MMT of O+OEG (DGH Report 2014-15).

In the basin, a total of 21 wells have been drilled, acquired satellite gravity survey data for an area of 2, 92,000 sq km, acquired 3D seismic data of 18,526 sq km and 2D seismic data of 27,061 km. During pre-NELP regime a well X, drilled in southern Fore Arc area and the well flowed gas @1, 92,000 m<sup>3</sup>/d from Miocene sequence that established hydrocarbon prospectivity in Fore Arc. In view of presence of hydrocarbon this geological setting, the area deserves more systematic G&G evaluation by acquiring additional data e.g. multichannel 2D/3D seismic, and carrying out special reprocessing, AVO analysis and detail Petroleum System modelling. As per current understanding, the Petroleum System model is more of a speculative in nature and in turn exploration in this set up involves high risk. In West Andaman so far no wells have been drilled due to poor understanding of the setup. On the contrary, though the Back Arc setting is more prolific no well have been due to restriction imposed by Department of Space, Government of India.

Exploration in such a high risk areas, besides using state-of technology- and techniques, does require attractive policy that initiated by Government to enable E&P companies for more investment to establish more hydrocarbon discovery and commercial field development. An attempt has been made to understand the hydrocarbon prospectivity and implication under new policy regime, HELP, to achieve desired goal. The approach may lead to put up Andaman in oil map of India.

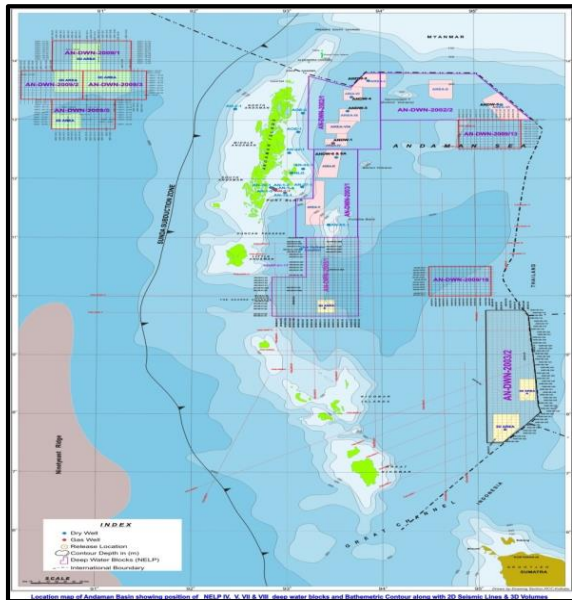
**Why to prioritize Andaman Offshore:**

At present due to low oil price regime for enhancing exploration, it is important to prioritize selection of acreage in terms of breakeven price. However, company to company and type of acreages, the breakeven price are different. The new hydrocarbon

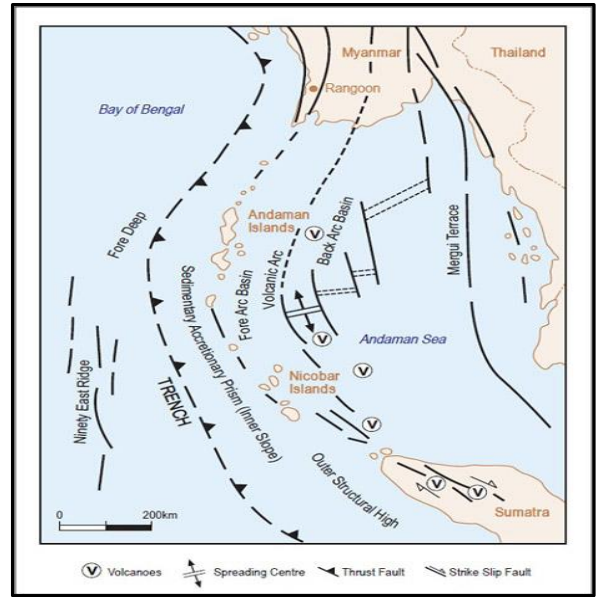
discovery in Offshore remain attractive for production at a breakeven price in the range of \$60-65/bbl. Production wells in new fields perform better and ultimately making fields more commercial drilling (*Oil Asia volume-Nov, 2015*). In the year 2015, techno-commercial evaluation have been carried out by ONGC for few deep to ultra-deep water blocks located in back arc and trench setup of Andaman basin. Considering gas case, the study shows for west Andaman area, the break even gas price comes out between \$ 6.0-6.8 mmbtu. For east Andaman offshore considering oil case, the break even oil price arrived at around \$ 48-52/bbl. (ONGCs internal report carried out for Andaman blocks, 2015)

In this scenario, available frontier area both in shallow and deep water set up in Andaman Offshore of Indian sedimentary basin may be looked into for aggressive exploratory activity that may lead to discover hydrocarbon find and develop new field for commercial production.

The acreage area and major tectonic elements in Andaman water witnessed Andaman Trench, Inner slope, Outer high/Trench slope break, Fore Arc, volcanic Arc, Back Arc and Mergui Terrace demonstrated in **Fig. 1 and Fig. 2** (after ONGC and DGH respectively).



**Fig. 1:** Index Map of Andaman Basin



**Fig.2:** Tectonic Setting of Andaman Basin

In the basin, the total prognosticated hydrocarbon resource worked out that is estimated in the order of 180 (O+OEG) MMT (DGH Report 2015-16). Moreover, production potential and hydrocarbon lead established in a well X from Miocene horizon warrants that Andaman Fore Arc is an emerging Sub-basin. The hydrocarbon source envisaged in the acreage both deeply buried thermogenic system in ponded Fore Arc and Biogenic/shallow gas system. (After DGH).

### Andaman Fore Arc, an emerging sub basin:

Andaman Fore Arc sub basin covered approximately more than 8000 Sq.km aligned in N-S direction between sedimentary accretionary prism (Inner slope) and Volcanic Arc system extended from Sumatra to Burma. The sedimentary section in the setting is dominated mainly with fluvial, shelf and deep marine set up. In the basin a total of 21 wells have been drilled and acquired about 27,000 LKM of 2D and 19,000 sq. km. of 3D seismic. In the basin, satellite Gravity survey data in the tune of 2, 92,000 sq km also acquired.

In Fore Arc setup, **well X** drilled to a depth of 3734m produces gas @ 1, 92,000 m<sup>3</sup>/d from limestone sequence (Middle Miocene). The sequence is mainly dominated with argillaceous limestone and minor sandstone that proved the presence of petroleum reservoir. Moreover in the well, encountered thick monotonous silty shale and clay section in Late

Miocene to Pliocene sequence confirmed the evidence of effective seal. The sequence in the interval Late Cretaceous to Oligocene age is mainly dominated with shale and occasional thin sand confirmed the presence of effective source facies. Moreover, in the well evidence of gas recorded in Kalapani Formation suggests that apart Miocene target, prospective area in Late Cretaceous to Eocene section can be taken up as a future target (after DGH).

Further, It is pertinent to mentioned here that during NELP-IV regime in the block AN-DWN-2002/1 located in outer Fore Arc setting, a total of 4 exploratory wells have been drilled and on MDT Gas Discovery from Pliocene sequence have been established in the Well ANDW-1 (After DGH 2011-12 report). Apart from this encouraging result, further evidence of gas indication in Lower Miocene section encountered in another well Y drilled during Pre NELP regime suggests that Andaman Fore Arc is an emerging sub Basin. Moreover, deep burial source at basinal low observed in analogous set up in Simeuleu Basin, Sumatra (Ref. Fig. 6) akin to Andaman fore Arc also confirms the existence of deeper source in Andaman.

Chasing these exploratory leads, it warrants immediate aggressive exploratory inputs e.g. multichannel seismic data acquisition, special processing, 3D petroleum system modelling and drilling of wells in Andaman Fore Arc Acreage.

The litho-facies encountered in the well X and seismic section passing through the well showing disposition of sedimentary sequence illustrates here as Fig. 3 and Fig. 4 (after DGH and ONGC respectively).

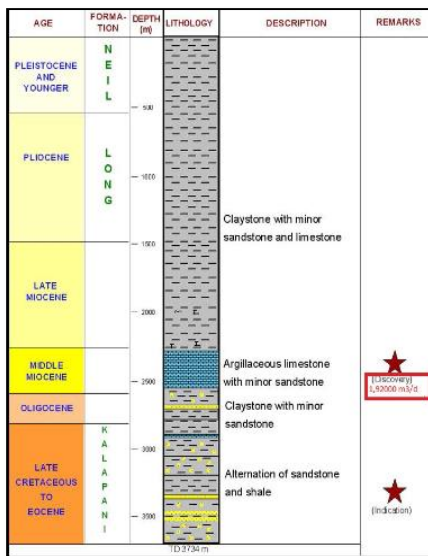


Fig. 3: Litho-column of well-X

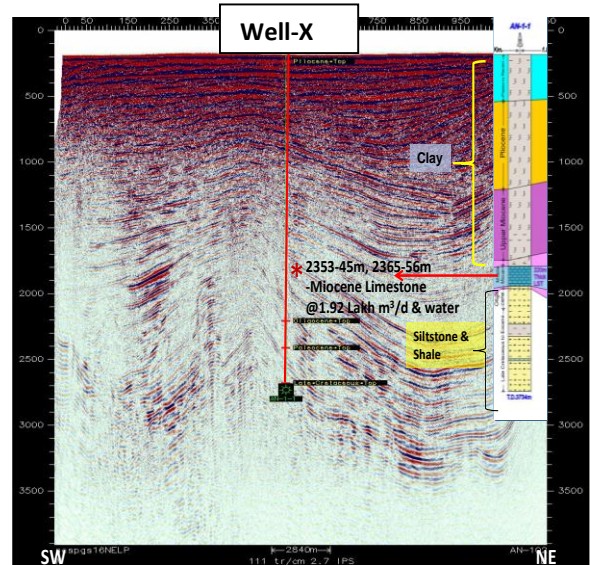


Fig. 4: Corresponding Seismic section

Based on the production data of the well-X, it is evident that the Miocene sequence has got the prolific occurrence of hydrocarbon. Further, Presence of bright spot/flat spot indicates the evidence of gas bearing reservoir and hydrocarbon migration from thermogenic source (After DGH)

**Petrophysical Properties of lead well-X drilled in Fore Arc set up:**

The log motif of the pay is interpreted (Ref. Fig. 5). The study shows that average petrophysical properties are Rt 8-9 Ohmm, Porosity (Phi) 22-24% and Density (RHOB) 2.2-2.3 gm/cc. In terms of these parameter of producing zone encountered in well X bears a better reservoir properties.

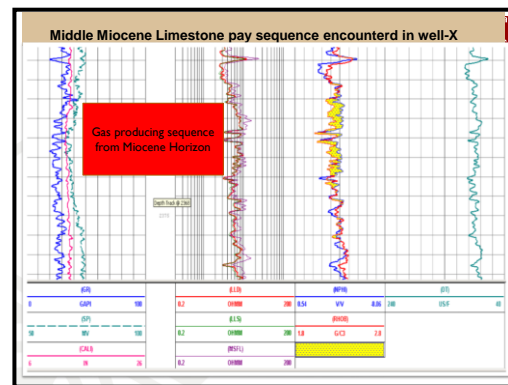
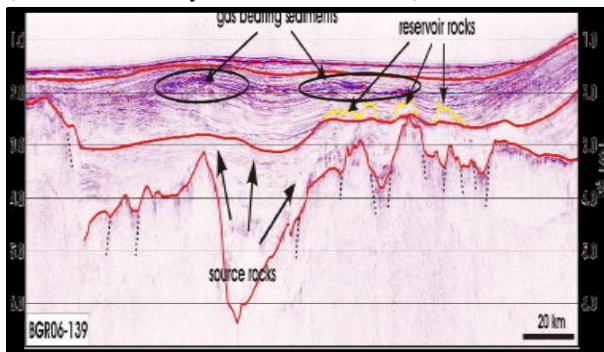


Fig. 5: Log motif of pay horizon. Well -X

## Prospectivity perception of nearest analogues Fore Arc acreage – Simeulue Basin

Similar to Andaman Fore Arc, Simeulue Basin off Sumatra has witnessed hydrocarbon potential in Carbonate platform (Ref. Fig. 6). The basin was generated as a result of plate subduction between outer-arc high and Simeulue main land. In the basin, multichannel seismic data was acquired and carried out special processing and AVO analysis. The study of 3D Petroleum System modelling of the basin suggests presence of wide spread Bright Spot in Mio-Pliocene sediment. Based on surface geochemical analysis, it is also evident the presence of thermogenically originated deep burial hydrocarbon source. Further, in the set up envisaged presence of two petroleum source (Eocene and Early to Middle Miocene).



**Fig. 6:** A conceptual seismo-geological model of Simeulue Basin akin to Andaman Fore Arc (After Ruediger Lutz and et.al, 2010)

## LNG- a business case of exploration in Andaman offshore

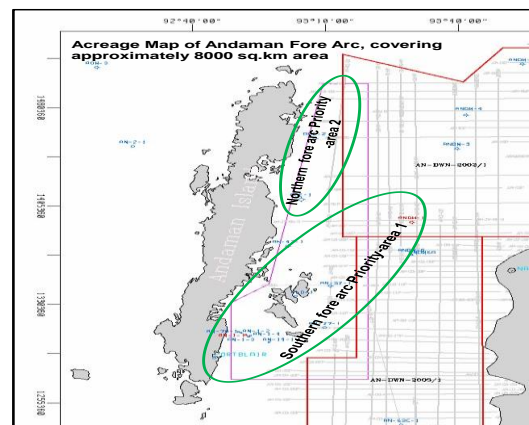
In order to bring domestic gas from Andaman offshore to the shore setting up of LNG plant may be one of the feasible way in near future. It is pertinent to mentioned that in East Coast of India there are four upcoming LNG terminal in Paradip (by GAIL), Kakinada (GAIL, GDF Suez, Shell), Gangavaram (Petronet LNG) and Ennore (India Oil) is scheduled to be operationalize in the year 2018-19 . In future, this approach will boost up gas marketing sector and more specifically KG/Mahanadi and Andaman Offshore in this regard to be benefited. For bringing gas produced from Andaman, LNG mode of transportation may be better alternative, provided the technoconomis hold.

### HELP Policy is enabler:

Under HELP and OALP, the E&P Company is now allowed to carve out its own block, based on its

prospectivity perception. Two kinds of contracts have been envisaged-Reconnaissance Contract and Petroleum Operation Contract. This provides flexibility to the E&P Company in selecting type of the contract, which was not available under NELP. The HELP policy is expected to be a dispute free contractual regime. All the information on G&G data, well data.no go areas will be known to the E&P companies in National Data Repository data base (NDR). Entire sedimentary basin has been divided into sectors of 10'x10', beforehand enabling E&P Company to make an optimized exploration strategy. The sectors can be combined into a contiguous maximum area of 20 sectors in shallow water and 30 sectors in deep/ultra-deep water area. Based on the availability of data of Indian sedimentary Basin, 3 types of zones have been identified in OLAP as Zone-1, Zone-2 and Zone-3. As Fore Arc Andaman holds more than 8000 sq km area, is falling under Zone-3, suitable contract area can be grouped both for Reconnaissance and Petroleum Exploration Contract for submission of Expression of Interest (Ref. www.ndrdgh.gov.in).

Based on the analysis, two priority areas are identified as area-1 and area-2. The area-1 is in southern Fore Arc covering the well-X including the Pliocene discovery established during NELP regime. The area-2 is northern part of Fore Arc. The area-1 requires to take up first. After arriving of the outcome of area-1, call requires to be taken for exploration in northern Fore Arc (Ref. Fig. 7 – After ONGC).



**Fig. 7:** Map of Fore Arc with identified target area

### Other salient features of HELP policy are as below:

- Single license environment covering all types of hydrocarbon both conventional and unconventional
- Open Acreage option to select exploration blocks
- Pricing and Marketing freedom

- Enhancement of Exploration Period
- Zero royalty for deep and ultra-deep water blocks for first 7 years to incentivize exploration
- No oil cess and custom duty exempted.

A comparative analysis of various advantages of HELP policy over the NELP is given below:

Parameter	HELP	NELP
<b>Exploration Period</b>	8 Years : Onland and Shallow water 10 Years : Deep water and Ultra-Deep water	7 Years: Onland and Shallow water 8 Years : Deep water
<b>Exploration in ML area</b>	Allowed	Not allowed
<b>Fiscal Modal</b>	Revenue Sharing	Profit Sharing
<b>Cost Recovery</b>	Not Applicable	Present
<b>Royalty rate</b>	Low for Offshore areas	Standard rates
<b>Role of MC</b>	Largely related to monitoring of MWP. More focus on reservoir health monitoring	Both on technical and financial aspect
<b>Revenue</b>	On production	After Cost recovery. i.e. from profit petroleum
<b>Single License</b>	Allowed for all types of hydrocarbon	Not allowed

In terms of royalty payment to Government for Onshore, royalty remains same as in NELP i.e. 12.5% for oil and 10% for gas. However in offshore, in order to incentivize exploration that involves higher risk and investment, a graded system of reduced royalty is applied under HELP. The applicable royalty rates area enumerated as below:

Area	Duration	Royalty rates under HELP		Royalty rates under NELP	
		Oil	Gas	Oil	Gas
Shallow Offshore	1 <sup>st</sup> 7 years	7.5%	7.5%	10%	10%
Deep water	1 <sup>st</sup> 7 years	0%	0%	5%	5%
	After 7 years	5%	5%	10%	10%

Area	Duration	Royalty rates under HELP		Royalty rates under NELP	
		Oil	Gas	Oil	Gas
Ultra-Deep water	1 <sup>st</sup> 7 years	0%	0%	5%	5%
	After 7 years	2%	2%	10%	10%

#### Conclusion:

1. In present analysis, the Andaman Fore Arc acreage as a case study has been taken up for study under the provision of OALP. In view of hydrocarbon finds of the Miocene sequence, presence of thick source facies and effective seal encountered in well X, better petrophysical properties of producing horizon, evidence of gas recorded in Late cretaceous to Eocene section along with Pliocene gas discovery established in the well ANDW-1 (Outer Fore Arc), two areas have been identified, Southern Fore Arc (area-1) and Northern Fore Arc (area 2) to prioritize exploration under HELP. In this regard, the setup have been correlated with analogous basin too and inferences corroborated. After reviewing the outcome of exploration in the Southern Fore Arc, judicious call require to take up northern Fore Arc acreage.
2. As Fore Arc Andaman holds more than 8000 sq.km.falling under Zone-3, suitable Contract Area can be grouped and EOI submitted for both types of Contract i.e. Petroleum Exploration Contract and Reconnaissance Contract. The approach may lead to convert Andaman into a Category-1 Basin.
3. To incentivize exploration in HELP regime, Government of India given dispensation of Zero royalty in first 7 years for deep and ultra-deep water and reduction of royalty from 10 to 7.5% for shallow offshore. In present scenario, based on the lead established in the well X and prospectivity perception envisaged, Andaman Fore Arc is a better case to prioritize more exploration to establish Hydrocarbon Discovery. Moreover as Government of India has exempted oil cess and custom duty and provided price and marketing freedom under HELP, the exploration in Andaman offshore at prevailing low oil price may become economical. The approach may lead to mark Andaman in oil map of India.

**References:**

1. Open Acreage License policy and HELP document of Government of India ([www.ndrdgh.dgh.in](http://www.ndrdgh.dgh.in)).
2. DGH Annual reports available in public domain ([www.dghindia.org](http://www.dghindia.org))
3. ONGCs internal report carried out for Andaman basin, 2015.
4. Ruediger Lutz. et.al, 2010, Petroleum System of Simeulue Fore-arc Basin off Sumatra, Indonesia (*AAPG International Conference and Exhibition, Rio de Janeiro, Brazil, November 15-18, 2009*)

**Acknowledgement:**

The authors express their gratitude and sincere thanks to Shri A.K Dwivedi, Director (Exploration), ONGC for his permission to publish the paper. The authors are thankful to Shri D. Purkayastha, Executive Director and Shri G.S Chaturvedi GM, ONGC for constant encouragement and valuable suggestion in writing the paper. The authors extend their sincere thanks to Group-Andaman of MBA Basin, ONGC for providing G&G data.

**Disclaimer:**

Views submitted in the paper are solely of authors only. Organization is not responsible in this regard.

