MINISTERIO DE ENERGÍA Y MINAS

Dirección General Hidrocarburos

PETROLEUM POTENTIAL CARIBBEAN OF NICARAGUA

2014

Introduction

Petroleum Potential in Nicaragua is documented by oil and gas indications and also by existence of good traps in both margins. This make the potential good to attract the invest of the petroleum industry. The exploration activities are regulated by the Law 286, “Ley Especial de Exploración y Explotación de Hidrocarburos” and its regulation, Decree No.43-98, and also by other laws and norms relative with exploration activities.

Introduction

- Politically, the NR is divided amongst 4 maritime zones: Honduras in the northwest, Nicaragua and Costa Rica in the southwest, Jamaica in the northeast, and Colombia in the south west.
- Site of modern carbonate banks. Potential reservoir related to reefs.

Available Areas Map

Methods applied for research exploration of hydrocarbons in the Caribbean of Nicaragua :

- STRATIGRAPHY
- SEISMIC REFLECTION
- DRILLING

STRATIGRAPHY

New perspective in Caribbean of Nicaragua….

Wells with Dolomitization of Limestone (Middle Eocene) Caribbean offshore

This dolomite section presents limestone with predominant shale. The dolomitization part of the Punta Gorda Formation is independent of the depositional environment and has calcite material.

Dolomite section can be observed in some seismic section as a free reflexion. In the region of the Tyra well this section is related with the Perlas reef structure.

New perspective in Caribbean of Nicaragua

Dolomite section in the Punta Gorda Formation of the Caribbean Margin of Nicaragua.

Litho-stratigraphic Column of the Nicaraguan Caribbean Shelf

Dolomite Troy from Middle Eocene was recognized by Occidental in the wells **Miskito-1 and Miskito-2** in the Punta Gorda Formation level. This dolomite sequences is stratigraphically similar to the one identified in some wells from Jamaica and Honduras. Offshore wells from Nicaragua indicate a range thickness of this section from 85´to 400´. Eight wells drilled in the Caribbean of Nicaragua identified this sequence and one well from Honduras.

Legend

- Oligo-Miocene
- Unit I.
- Unit II.
- Unit III.
- Unit IV.
- Unit V.
- Acoustic Basement

CHART OF MAIN STRATIGRAPHIC CORRELATION
Across Nicaragua, Los Cayos and Colombia Basins

SEISMIC REFLECTION

Total seismic in Caribbean of Nicaragua

TOTAL 2D SEISMIC : 39. 596 **Km**

22, 918 Km	2D	Caribbean Offshore	1966-1980.
3, 095 Km	2D	Caribbean Offshore	1999/2000
	2D	Caribbean Offshore	2011
4, 915 Km^2	3D	Caribbean Offshore	2011
	2D	Caribbean Offshore	2013

Areas Awarded for Oil Exploration and Exploitation

Caribbean Offshore of Nicaragua: **13 657** km^2

3 922 km^2	Noble Energy Nicaragua Limited
3 909 km^2	Noble Energy Nicaragua Limited
3 325 km^2	Infinity Energy Resources, Inc.
2 268 km^2	Infinity Energy Resources, Inc.

Seismic Map

Seismic Surveys, Caribbean of Nicaragua
HONDURAS
COSTA RICA
Cayo Quitasueño
Cayo Serrana
Isla Providencia
Isla San Andrés
Mar Caribe
Legend
2D Seismic, USA Co
2D Seismic, Noble 2013
2D Seismic, Infinity 2013
3D Seismic, Noble 2011
85°0'0"W
84°0'0"W
83°0'0"W
82°0'0"W
81°0'0"W
80°0'0"W
79°0'0"W
15°0'0"N
14°0'0"N
13°0'0"N
12°0'0"N
11°0'0"N

DRILLING

WELL	COMPANY	YEAR	TD (m)	INTERV. (m)	Oil & Gas Shows	API	Ø	FORMATION	AGES OF OCCURANCE
CARIBBEAN MARGIN									
Diriangen 1	Unocal	1975	1,967	600-1200				Martinez Reef	Miocene to recent
								Mosquitia	Oligo-Miocene
Coco Marina	Unocal	1969	3,047	1400-1500				Punta Gorda	Upper Eocene
				2500-2800				Touche	Middle Eocene
Ledacura	Unocal	1977-8	3,791	1533-1716				Mosquitia	Miocene
								Kamanón	Upper Eocene
				1978-2006	C1 - C4			Punta Gorda	M. & Upper Eocene
Huani 1	Unocal	1974	3,468	1125-1743	1bbl/d	30°		Mosquitia	Miocene
				3169-3462	7 bbl/d	36°		Touche	M. to Lower Eocene
Huani 2	Unocal	1977	1,816	474-878			28%	Martinez Reef	Miocene to recent
				900-1050	C1			Mosquitia	Miocene
				1081-1088		26°	28%	Kamanón	Lower Miocene
				1164-1580		36°	28%		
Tuapi 1	Unocal	1978	3,923	381	C1			Mosquitia	Miocene
				1800-2000	C1 - C4			Kamanón	Lower Miocene
				2400	C1 - C4			Punta Gorda	Upper Eocene
				3899-3466			20%	Touche	Eocene
Miskito 1	Occidental	1970	2,027	1262-1838				Punta Gorda	Middle Eocene
									Upper Eocene
Perlas 1	Shell	1968-9	3,800	1737			10%	Kamanón	Oligo-L. Miocene
								Punta Gorda	M. & Upper Eocene
				3246-3342	350 bop	21-26°	12%	Touche	Lower Miocene
Perlas 3	Shell	1970	3,802	1358-1981			10%	Kamanón	Oligocene-L. Miocene
				2250			10%	Punta Gorda	Middle Eocene
Martinez Reef	Unocal	1968	3,683	2150-3200				Punta Gorda	Upper Eocene
								Touche	Eocene

Oil & Gas Indications of Wells Drilled in Nicaragua

Wells Map

TOTAL WELL DRILLED: 27

26 Exploratory Wells Offshore Caribbean 1965-1974
1 Exploratory Well offshore Caribbean 2013

Hydrocarbon Potential

Potential Areas Description

1. Ledacura Area
Carbonates from Eocene with good properties to reservoir. Good clastic grains as well. Possible generation oil under 2600 meters. Two wells drilled on main structure

2. Wonta-Bismuna high
Upper Eocene constitutes by carbonates and clastic sediment with basal origin can be good reservoir. Twara -1 well gave some oil and gas shows.Some onshore wells indicated an inmature source rock.

3. Diriangen Area
Triangular depression with reefs associates to limestone can act as a good reservoir. Eocene section reach a thickness of 300 meters with porosity between 10%-25%. Clastic sandstones and lutites from Oligocene are present. Source rock is related with Lower Eocene age. Red bed and evaporites from Lower Cretaceous drilled in Honduras were not drilled in the Nicaragua side which are expected to be in the deeper part. Huani 2 well bottomed 1817 meters. Structural inversion may be responsible for complex migration an trapping mechanism.

4. Tuapi Trend
Drag folds structures were identified near this area which spread to Huani,Diriangen and Quita Sueño areas. A mature source rock was drilled in this region. Carbonates and sandstones from Eocene and Oligo-Miocene respectively can act as a good reservoir. Oil and gas shows were obtained from Huani 1 well.
A thick dolomite section of 85 feet from Middle Eocene gave some gas show. Oil shows in Huani1 were coming from Eocene which is not present in the well region.

5. Miskito High
Bioclastic limestone from Eocene and possible reefs in the Oligo-Miocene. Two wells drilled on a closure structure in the Miskito area identified a dolomite section with a thickness between180 to 455 feet. The porosity of the section in the Miskito 2 well was 20%. Oil show of 23 ˚ API was reported.

6. Quitasueño Deep
Sincline structure with Eocene carbonates and Oligo-Miocene sandstones of deltaic systems.The thickness is 10,000 meters from Eocene to Recent. A subsequent and progressive uplift of the ridge in response to wrench faulting may explain truncation observed. Oil kitchen may have occured in the area. Oligo-Miocene and Upper Eocene can act as a good reservoir. Thick sediments related with good reservoir characteristic in the mature oil window might be possible to find.

7. Nasa Trend
Limestone and carbonates from Eocene underlying siltstone section from Oligo-Miocene, which can act as an excellent reservoir. Organic matter related with mixed sediments are present. Two wells drilled on a complex structure gave oil show from a thick dolomitic section of 125 feet. Large positive structure with thick Eocene of 4000 m

8. Prinzapolka Trend
Carbonates with secondary porosity under unconformity. A good quality of reservoir from Lower Eocene.Prinzapolka well identified an organic matter, mainly continental type. Middle Eocene thickness 2000-3000 m

9. Escondido-Rama Area
Eocene carbonates reservoir with good quality. Source rock maduration took place in the Eocene and have continental organic matter.

10. Verolania Basin
Carbonates with porosity between 5 to 10 %. The entirely area had a Lower Eocene maduration Perlas 3 well identified Lower Eocene reservoir and dolomitic sediments of 325 feet.Testing results in Perlas 3 identified four source rock with organic matter from Middle to Early Eocene. Perlas 1 well gave oil show with 36 ˚API and dolomite sediments were also identified. The oil producted in Perlas 1 was probably generated by carbonate sediments.

11.Nica-Tinkham Ridge
Carbonates or interdigitation of clast with volcanics layers, probably cause generation of source rock.Tyra-1 well identified 170 feet of dolomite section.Nica 1 well gave presence of oil in the Miocene section under 300 meters.

12. Centeno Area
Eocene carbonates, sandstones and volcanic sequences are present.Faulting dome structure with thick carbonates was identified. Clastics reservoir, such as sandstones with 20% of porosity, thickness of 300 meters. Shale sequence can act as a good seal. New seismic data identified carbonates reefs and carbonates shale. An asymmetrical tilted graben unfilled by Oligocene-Miocene to Recent sediments is present between Chiripa fault and San Juan High. Eocene sandstones can act as good reservoir, which are covered by Eocene shale. OligoMiocene carbonates with 1500 thickness, there is good closures, good conditions and seal is expected to be present.

13. Nica-Tinkham Ridge East
Probably Tertiary rocks, greenschist type with a volcanic clastic content. Elongated structure of 60 km long have Eocene sediments onlaping the ridge.Draping structure in the Eocene canbe observed.

14. San Juan Area
No drilled wells.

Well Correlation

CARIBBEAN BASIN CHARACTERISTIC

Type of Basin:	**Back Arc basin**
First well drilled onshore:	**Punta Gorda-1**
First well drilled offshore:	**Touche-1 (abandoned after a blowout at the total depth of 4420m)**
Encourage Oil and gas shows:	**Perlas-1 (accumulative production of 350 B/D asphaltic, 3223 mt, Lower Eocene)**
Good Reservoir:	**Clastic and Carbonates**
Economic Basement:	**Reached in Twara-1,Centeno-1, Toro Cay-1, Miskito-1and Rama- 1 wells**
Late Cretaceous:	**Reached by Nica-1 (Cretaceous source rock is expected to be present on the basin somewhere.**
Sources rock:	**Lower Eocene (Kerogene type I and IV, marine type, Perlas-1)** **Eocene Carbonates in Tuapi-1, produced 61 BOPD and 979 CMG, 3110 meters.** **The gas recovered supports the hypothesis of a unique source rock in the Eocene.** **No source rock was identified in the northern part suggest the existence of an older source rock that has not been drilled**
Reservoir rock:	**Carbonate and Clastic from Eocene and Oligo-Miocene, delta, carbonates platform and reef, Miskito-2, Nasa Cay-1, Huani-1 y 2**
Seal Rock:	**In the northern part prodeltaic shale and carbonate (Oligo-Miocene, Upper Eocene).** **Evaporites and shale were not found.**
Traps:	**Structural and stratigraphic from Oligo-Miocene and Eocene underlying the unconformity.**
Geothermal Gradient:	**3.5ºC in the North, 3.0ºC in the Central part, and 2.5 ºC in the South.**
Samples analysis:	**Black shale outcropping in Siuna locality, overmature source rock due to volcanic activity.** **Kerogene was as high as 77%.** **Cretaceous shale may act as an excellent source rock under normal geothermal gradient. Source rock in Huani-1 is Eocene or possible older perhaps equivalent to Siuna samples.** **Cretaceous Black Shale is expected to be found in the deepest part of the basin. This source was reached in the Limon Basin in Costa Rica.**

Companies who have worked in the Caribbean, Nicaragua

SURVEY NAME	YEAR	SHOT FOR	SHOT BY	PROCESSED BY	KM.
Buttes Resources Inc.	1977	Buttes	Delta	Seiscom Delta	1,729
Chevron Nicaragua	1966-1980	Chevron	Western	Western	3,951
Mobil Oil Co.	1968-1969	Mobil	GS/Delta	GSI/Mobil	4,383
Pure Oil Co.	1966	Western			833
Shell Oil Co.	1966-1970	Shell	GSI	GSI	6,270
Texaco Oil Co.	1974-1975	Texaco	GSI		2,297
Union Oil Co.	1973-1977	Union	Union	Digicon	3,455
NCS99	2000	Fugro-Geoteam	Fugro-Geoteam	Fugro-Geoteam	3,095
NCSRE00 **Reprocessed data**	2000	Fugro-Geoteam	Fugro-Geoteam	Fugro-Geoteam	7,200

Conclusion

- Sedimentary thickness of the Miskito basin varies from 2,000 meters in the South to 10,000 meters in the North. These sedimentary succession was deposited during the Tertiary to Recent Times.

- Seismic interpretation and structural map in the central and southern part indicate:
  - Intense thrusting and strike slip faulting
  - Tectonic blocks controlled the sedimentation, particularly the development of reef system along the elevated parts of fault blocks.

- The Nica-Tinkham ridge is the result of trans-pressional deformation along a major strike slip fault.

- Several wells drilled near the Perlas area had oil shows and the Perlas -1 well tested 350 bop with 36 ºAPI in the Eocene carbonate reservoirs.

- Rich mature source rocks were also identified in some wells.

- The Lower Eocene Facies are related with reef and fore reef system and also pinnacle reef system that can act as good limestone reservoir.

- Four source rock interval were identified in Perlas-3 with organic matter from Middle to Early Eocene.

- Dolomitic section were identified in some northern wells with good thicknesses, which can act as a good reservoir.

- Carbonates with porosity between 5 to 10% were identified in the Verolania basin, central part of the Miskito Basin.

- Faulting's dome structure with thick carbonate have been identified in the Centeno Area.

- The Miskito basin has a sedimentary thickness that varies from 2,000 meters in the South to 10,000 meters in the North, their sediments were deposited during the Tertiary to Recent Times. Seismic interpretation and structural map in the central and southern part indicate:

  - Intense thrusting and strike slip faulting.

  - Tectonic blocks controlled the sedimentation, particularly the development of reef system along the elevated parts of fault blocks.

- Several wells drilled near the Perlas area had oil shows and the Perlas -1 well producted 350 bop in the Eocene carbonate reservoirs related with dolomitization of limestone.

- The Lower Eocene Facies are related with reef and fore reef system and also pinnacle reef system that can act as good limestone reservoir.

- The Bahamas Reef Systems provides a perfect analog for the sedimentary environment and facies geometry for the Eocene offshore Nicaragua.

THANKS FOR YOUR ATTENTION

More information: www.mem.gob.ni