



# **EXPLORATION POTENTIAL** OF THE CAMISEA AREA AND THE MADRE DE DIOS BASIN (FTB)

Studies and exploration activity in the Ucayali and Madre de Dios basins show that there is gas potential in the area and that the implementation of new technologies could greatly reduce exploration risk: reprocessing of existing seismic, acquisition of new seismic, magnetotelluric studies and drilling of identified prospects could lead to the confirmation of new hydrocarbon volumes.

# CAMISEA

The history of exploration of the Camisea gas fields, in the Ucayali Basin, began in 1981 with exploration in Blocks 38 and 42 by Royal Dutch Shell. Between 1984 and 1987, Shell discovered the Camisea gas in the exploratory well San Martin 1, in what was then Block 42 and the Cashiriari and Mipaya discoveries.

In 1988, as no agreement was reached between Shell and the Peruvian government, Shell pulled out of the Camisea exploitation project, which required an investment of US\$ 2.5 billion. Investments during the first years of exploration were valued at some 200 million dollars.

Finally, after several years, in March 1994, Shell signed an agreement with Perupetro S.A. to conduct a feasibility study of the Camisea project in order to assess the potential, the technical and economic feasibility of the exploitation, and to prepare a development plan.

In May 1996, the Shell-Mobil Consortium began negotiations to begin exploiting Camisea. Since there was no market in Peru to justify the exploitation of gas, Shell had to prioritize the export of gas to Brazil. Subsequently, because the Peruvian government did not accept the development of an integrated project (exploration, extraction, transportation and distribution), the consortium decided not to proceed with the second phase of the project in July 1998.

An issue that is usually overlooked is that initially the Camisea project included the Mipaya and Pagoreni fields. The call for public bids for the new Block 88, which was awarded to the Camisea Consortium and operated by Pluspetrol, excluded the aforementioned fields from the award process. Thus, the State set aside part of the reserves for future unforeseen situations in relation to the domestic market. In February 2000, the Mipaya and Pagoreni fields, with proven reserves of 2.8 billion cubic feet and 225 million barrels of natural gas liquids, now called Block 56, were handed over to the Camisea Consortium, which destined them exclusively for export. In order to render viable the signing of an export contract, the government authorized a loan of 1.4 billion cubic feet of gas from Block 88.

To date, the Camisea Consortium is comprised of Pluspetrol (operator), Hunt Oil, Repsol, Sonatrach, SK Innovation and Tecpetrol.

In 2008, Repsol announced the discovery of gas in the Kinteroni 1X exploratory well in Block 57, located in the Camisea structural alignment. The Kinteroni field structure has a length of over 22 kilometers, and approximately 115 meters of net gas and condensate reservoirs. In 2012, Repsol drilled the Sagari 4XD well, discovering gas and condensate in this structure.

Block 58 was initially operated by PETROBRAS under a contract signed on July 12, 2005.

Subsequently in 2013, CNPC bought all the shares, and undertook the operations and the responsibility of Petrobras' obligations on Block 58, it took over the EIA procedure of the project called "Prospecting of 782.41 km of 2D seismic lines and Drilling of up to 12 exploratory wells in Block 58", which was approved by the Ministry of Energy and Mines in 2015. The block has discoveries in the Paratori (2013), Taini (2011), Picha (2010) and Urubamba (2009) fields.





Location of the Camisea fields. Blocks 56, 57, 58 and 88 in the district of Megantoni, Cusco.



Stratigraphic column with the elements and events of the Petroleum System.

Source: PETROBRAS (2012)



# EXPLORATION POTENTIAL OF THE CAMISEA AREA -UCAYALI BASIN

# **BLOCK 56**

# Background

Block 56 encompasses the Mipaya and Pagoreni fields, adjacent to Blocks 88 and 57.

The Mipaya structure is an elongated anticline approximately 11 km long and 3 km wide with 4-way closure and counter fault. It was drilled for the first time on the northern flank by Shell with the Mipaya 5X well in 1987. In 2009, the Camisea Consortium recorded 3D seismic over the Mipaya structure; then, in 2011, it drilled the Mipaya 1001XD well, proving the presence of gas in the Noi and Ene reservoirs and explored the upper Copacabana formation, thus being the first exploratory well to be brought into production. Cumulative production from this field is 353 BCF. The Pagoreni structure is an elongated anticline approximately 25 km long and 6 km wide and follows a northwest-southeast direction. The field was discovered by Shell in 1998 with the drilling of the Pagoreni 1X ST2 well, and the Basal Chonta and Nia reservoirs were found to be saturated with gas. Confirmatory activities were carried out in 2006 and confirmed the production capacity of the Nia formation. The field has a cumulative gas production of 1,804 BCF.

Producing reservoirs for the Mipaya and Pagoreni Field cover the Upper Permian and Lower Permian.



Exploratory data Block 56

# **Exploration opportunity**

To date, the Pagoreni Deep Horizon Prospect and the Pagoreni Triangular Zone Lead have been identified. The following table shows the estimated volumes of prospective resources in the structures.

#	Name	Class	Prospective Resources Gas (2U) (BCF)	Туре
1	Pagoreni <i>Deep Horizon</i>	Prospect	187	Structural
2	Pagoreni Triangular Zone	Lead	183	Structural



Structure Locations Block 56

## Pagoreni Deep Horizon Prospect

Name	Class	Formation	Area (acres)	Prospective Resources Gas (2U) (BCF)	Author/ Year
Pagoreni Deep Horizon	Prospect	Copacabana Tarma Green Sst Ambo	5,189.2	187	Pluspetrol 2019



## Pagoreni Triangular Zone Lead

• The Pagoreni Triangular Zone structure has the category of Lead, despite having 3D seismic coverage and no similar wells drilled.

Name	Class	Formation	Area (acres)	Prospective Resources Gas (2U) (BCF)	Author/ Year
Pagoreni <i>Triangular Zone</i>	Lead	Vivian, Lower Chonta, Nia & Basal Chonta	1,334.37	183	Pluspetrol 2019





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# **BLOCK 57 AND SURROUNDINGS**

# Background

Block 57 encompasses the Kinteroni and Sagari fields, adjacent to Blocks 88 and 56.

The Kinteroni structure is an anticline with structural 4-way closure, the eastern flank is defined against a northwest-southeast aligned fault. This structure is 15 km long and 3.5 km wide. The exploratory well Kinteroni 57-29-1XST confirmed that the Kinteroni structure is not linked to the Mipaya structure located in Block 56. The Sagari structure is an anticline with structural 4-way closure, the eastern flank is defined against a northwest-southeast aligned fault. This structure is 10 km long and 3 km wide. The Sagari 57-22-4XD exploratory well discovered the Sagari structure and found the producing reservoirs that extend from the Upper Permian to the Lower Permian.



# **Exploration opportunity**

To date, the Mapi Sub Thrust and Maniro Leads and the Mapi South Play have been identified. The following table shows the estimated resource volumes for the Leads.

#	Name	Class	Prospective Resources Gas (2U) (BCF)	Туре
1	Mapi Sub Thrust	Lead	644.7	Structural
2	Maniro	Lead	309.6	Structural
3	Mapi South	Play	-	Structural



Structure Locations

# **Actions for Value Enhancement**

- Seismic acquisition programs in the area adjacent to Block 57 to upgrade the Leads and Plays to Prospects.
- Magnetotellurics could improve the understanding of the structural model by acquiring new information, as well as thermal tomography studies that would provide information on migration pathways and the presence of hydrocarbons by means of indicators.
- Upgrade the Maniro Lead to Prospect.

#### Mapi Sub Thrust Lead

Name	Class	Formation	Area (acres)	Prospective Resources Gas (2U) (BCF)	Author/ Year
Mapi Sub Thrust	Lead	Upper Nia Lower Nia Noi/Ene	8,849	644.70	Perupetro 2019



Map Top Upper Nia (TWT)



#### **Maniro Lead**

Name	Class	Formation	Area (acres)	Prospective Resources Gas (2U) (BCF)	Author/ Year
Maniro	Lead	Upper Nia Lower Nia Noi/Ene	2,384.8	309.60	Repsol 2019





#### **Mapi South Play**



# BLOCK 58

# Background

Four gas and condensate fields have been discovered in Block 58: Urubamba, Picha, Taini and Paratori, which are located in the structural train north of Block 58, where 3D seismic was acquired in 2011 (726 km<sup>2</sup>).

Other prospects have also been identified and defined in this area using 2D seismic: Picha Profundo and Puerto Huallana, both located in the same structural train as the discovered fields.

In the last 2D seismic acquisition campaign conducted in 2018, CNPC Peru acquired 233 km of 2D seismic in the western area of Block 58. In addition, 189 km of former 2D seismic were reprocessed to complement the analysis of the area where some leads showing potential were defined. Further analysis and information is needed for

them to be catalogued as prospects.

Urubamba is the most important structure in Block 58. It is located in the southeast of the block and is the shallowest structure. The structural culmination at lower Nia is at-3,120 m below sea level (TVDSS) and corresponds to a faulted anticline with structural 4-way closure and a reverse fault to the north. The structural axis has a general east-west strike, dipping to the west. The strike of the main fault is parallel to the anticlinal axis.

The producing reservoirs for the Taini, Picha, Paratori and Urubamba fields range from Upper Permian to Lower Permian.





**The Picha 58-21-2X well** proved 43.9 API oil in Lower Nia.

The Taini 58-13-3X well proved 46.0 API oil in Ene, 47.0 API oil in Lower Noi and 50.0 API oil in Upper Noi.

The Urubamba 58-29-

**1X well** proved 55.0 API oil in Ene, 58.0 API oil in Lower Noi, 56.5 API oil in Upper Noi and 53.0 API oil in Lower Nia.

Exploratory data Block 58

# **Exploration opportunity**

To date, two prospects and five leads have been identified as exploration opportunities in the block:

#	Name	Class	Prospective Resources Gas (3U) (BCF)	Prospective Resources NGL (3U) (MMSTB)	Туре
1	Picha Profundo	Prospect	590	23.5	Structural
2	Puerto Huallana	Prospect	762	30.4	Structural
5	Structure 13	Lead	328	13.1	Structural





# **Actions for Value Enhancement**

• Picha Profundo and Puerto Huallana Prospect Drilling.

## **Picha Profundo Prospect**

			Area	Prosp Reso	Author	
Name	Class	Formation	(acres)	Gas (3U) (BCF)	NGL (3U) (MMSTB)	/Year
Picha Profundo	Prospect	Middle Nia Lower Nia Upper Noi Lower Noi Ene Copacabana	1,705	590	23.5	CNPC 2018





## **Puerto Huallana Prospect**

		<b>.</b>	Area	Prosp Reso	ective urces	Author
Name	Class	Formation	(acres)	Gas (3U) (BCF)	NGL (3U) (MMSTB)	/Year
Puerto Huallana	Prospect	Middle Nia Lower Nia Upper Noi Lower Noi Ene Copacabana	2,594.6	762	30.4	CNPC 2018







• Move forward with studies of these structures in the high blocks to upgrade them and then evaluate the potential of the low blocks, which have not been reached so far

Structure 13 Lead

			A #0.0	Prospectiv	Author		
Name	Class	Formation	(acres)	Gas (3U) (BCF)	NGL (3U) (MMSTB)	/Year	
Structure 13	Lead	Middle Nia Lower Nia Upper Noi Lower Noi Ene Copacabana	1,408.5	328	13.1	CNPC 2018	01000218







# Structure 5 & 6 Lead

Name	Class	Formation	Area (acres)	Author/Year
Structure 5	Lead	Upper Noi Lower Noi Ene Copacabana	494.2	CNPC 2018
Structure 6	Lead	Middle Nia Lower Nia Upper Noi Lower Noi Ene Copacabana	593.1	CNPC 2018







Structural map at the top of Lower Nia



#### Structure 16 Lead

Name	Class	Formation	Area (acres)	Author /Year
Structure	Lead	Middle Nia	444.8	CNPC 2018
16		Lower Nia		
		Upper Noi		
		Lower Noi		
		Ene		
		Copacabana		





Structural map at the top of Lower Nia

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#### Structure 17 Lead

Name	Class	Formation	Area (acres)	Author / Year
Structure 17	Lead	Middle Nia Lower Nia Upper Noi Lower Noi Ene Copacabana	815.4	CNPC 2018





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# BLOCK 88 Background

Three gas and condensate fields have been discovered in Block 88, located in the structural train north of Block 58: San Martin, Cashiriari and San Martin East.

The San Martin structure is an elongated anticlinal fold approximately 19 km long by 6 km wide, with 4-way closure, and is part of a northwest-southeast strike structural alignment that also includes the Pagoreni and Mipaya anticlines, which are separated by structural saddles.

The Cashiriari structure is an elongated anticlinal fold in a west northwest- east southeast direction. At the depth of the main reservoirs it extends for approximately 35 km and

has a width of 7 km. The anticline is slightly asymmetrical with the northern flank being steeper, up to 37° and the southern flank steeper, with more than 40°, and shows structural 4-way closure.

The San Martin East structure is part of the structural train that aligns the San Martin, Pagoreni, Mipaya and Kinteroni anticlines. This structure is an elongated anticline approximately 7 km long by 2 km wide and has a 4-way closure.

The producing reservoirs for the San Martin, Cashiriari and San Martin East fields extend into the Upper and Lower Cretaceous and Paleozoic.



# **Exploration opportunity**

To date, three prospects have been identified as exploration opportunities in the block:

#	Name	Class	Prospective Resources Gas (2U)(BCF)	Туре
1	Cashiriari Deep Horizon	Prospect	390	Structural
2	San Martín <i>Deep Horizon</i>	Prospect	245	Structural
3	San Martín <i>Triangular Zone</i>	Prospect	352	Structural



Structure Location Block 88

# **Actions for Value Enhancement**

Drilling of the Cashiriari Deep Horizon and San Martin Triangular ٠ Zone Prospects.

## Cashiriari Deep Horizon Prospect



## San Martín Deep Horizon Prospect

Name	Class	Formation	Area (acres)	Prospective Resources Gas (2U) (BCF)	Author / Year	VIDOO	74000		SAN MARTI Plugged an Gas and Co Year: 1984	N 42-46-1X d Abandoned indensate Well
San Martín <i>Deep</i> Horizon	Prospect	Copacabana Tarma Green Sst Ambo	5,535.2	245	Pluspetrol 2018	Droom	SAN MARTING - 18-18-18-	UNATIVE STE ST	87.1-1001XD-+	KMARD 884-M69105-
à	/ =					to the second s	CASHINARI 43.42 YA CASHINARI 43 CASHINARI TICON Gay Condemasto Perforadas	28-14		

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#### San Martín Triangular Zone Prospect

Name	Class	Formation	Area (acres)	Prospective Resources Gas (2U) (BCF)	Author / Year	00001
San	Prospect	Vivian	1,927.4	352	Pluspetrol	
Martín		Lower Chonta			2019	870000
Triangular		Nia & Basal				
Zone		Chonta				





# **EXPLORATION POTENTIAL OF THE MADRE DE DIOS BASIN**

# Background

Exploration activities in the Madre de Dios basin date back to 1970. In 1974, Cities Services and Andean Petroleum acquired approximately 2,800 km of 2D seismic. As part of the commitments in the area, Cities Services drilled the exploratory wells Rio Cariyacu 1X, Los Amigos 2X and Kareme 3X, and Andes drilled Pariamanu 1X and Puerto Primo 2X only the Karene well was drilled in the fold belt. The wells were drilled on Paleozoic Structures and also on Cretaceous Structures with a monocline inclination with no Structural closure. Although there were gas and oil shows in some Paleozoic reservoirs, the quantities were considered noncommercial. In 1976, in the northwestern part of the basin, the Karene 3X well was drilled to a depth of 3,665 m MD. It drilled only the upper Tertiary section, but due to compressive stresses it was impossible to complete the drilling program.

Although no shows were found during drilling, a later geological survey (1995) found traces of hydrocarbons in the drilling mud.

In 1985, Shell acquired 505 km of 2D seismic in blocks 49 and 51. This acquisition was part of the 2000 km campaign.

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In the early 1990s, Mobil drilled five wells in the Bolivian part of the basin, with the Pando well being the discovery well, which also identified the Devonian as the source rock. As a result of Mobil and Shell's work, a TEA (Technical Evaluation Agreement) was signed over an area of 8.9 million hectares.

Subsequently, in negotiation with Perupetro, exploration contracts were signed in Block 77 (Las Piedras) and Block 78 (Tambopata). In Block 78, 570 Km of 2D seismic were acquired and the well CANDAMO-78-53- 1X/ST was drilled to a depth of 3,887 m MD in 1999. Five formation tests (DST) were performed and as a result, gas and condensate production (approximately 10 MMCF/D) was proven from the Lower Chonta, Upper and Lower Nia units. This is the only well in the fold belt of the Madre de Dios basin that has proven gas and condensate, and also proved the performance of the petroleum system to date.

Between 2009 and 2010, Hunt Oil conducted exploration activities and acquired 2D seismic information to further investigate the prospectivity of the Foreland area. Based on new 2D seismic, reinterpretation of previous seismic sections, as well as the results of exploratory wells drilled in the surrounding areas, the DAHUENE 76-60-A-1X exploratory well was drilled to a depth of 3,070 m MD between December 30, 2014 and May 10, 2015. The well was drilled to the programmed depth; however, it did not reach the planned objectives, only reaching the tertiary in the Yahuarango Formation. During drilling, a loss of 19,520 bbl of mud was recorded in the 20" phase; furthermore, the cutting samples did not show traces of fluorescence in the intervals traversed, and therefore, the decision was to abandon the well. None of the target formations were reached after drilling the DAHUENE 76-60-A-1X well because it got hung up in the Tertiary layers, leaving the structure with the estimated potential.

The image shows the stratigraphic column with the reservoirs that could accumulate gas and condensate and the elements of the petroleum system for the Fold and thrust belt (FTB) of the Madre de Dios Basin.



Source: HIDRO-CARBUROS CONSULTING (2017)



Madre de Dios Basin Exploratory data

# **Exploration opportunity**

To date, five Prospects, seventeen Leads and three Plays have been identified as exploration opportunities in the Fold and thrust belt (FTB) area of the Madre de Dios basin, as a result of exploration activities carried out since the 1970s.

Class Number of Structures		Prospective Resources Gas (Mean) (BCF)	Туре
Prospect	5	5,404	Structural
Lead	17	12,826	Structural
Play	3	-	Structural



Madre de Dios FTB Structure Location



*Seismic sections in the Madre de Dios Basin* 

Source: Block 111, SAPET





# **Actions for Value Enhancement**

- Seismic acquisition with new technologies in the SM53-19 area. The existing information was acquired in the 70s, 80s, 90s, 2009 and 2010. Conduct special processing for the fold belt to the historical and new seismic, such as deep processing with migration algorithm like RTM (Reverse Time Migration), GBM (Gaussian Beam Migration), TTI (Tilted Transverse Isotropy), CRAM (Common Reflection Angle Migration).
- Acquisition of magnetotellurics to improve the understanding of the structural model and perform thermal tomography studies to provide information on migration pathways and presence of hydrocarbons through indicators.
- Conduct drilling method studies for fold belt areas such as Casing while Drilling (CwD) or others. Casing while drilling (CwD) is a drilling technique that has proven to alleviate many of the problems faced in drilling and drilling efficiency.

#### Madre de Dios Fold Thrust Belt Prospects



#	Prospect	Prospect	tive Resources
#	Prospect	Gas (BCF)	NGL (MMSTB)
1	Azulmayo	726	11.03
2	Chaspa	1,056	16.06
3	Loromayo	571	8.67
4	Tabari West	210	3.18
5	B6	2,841	152.00
TOTAL		5,404	190.94

## **Azulmayo Prospect**

		A #00	Prospect	ive Resources	
Class Formation (a		Area (acres)	Gas (BCF)	NGL (MMSTB)	Year
Prospect	Lower Chonta Upper Nia	6,671.8	726	11.03	HC 2017
ן י	lass rospect	lass Formation rospect Lower Chonta Upper Nia Lower Nia	IassFormationArea (acres)rospectLower Chonta Upper Nia Lower Nia6,671.8	IassFormationArea (acres)ProspectrospectLower Chonta6,671.8726Upper Nia Lower NiaLower Nia11	IassFormationArea (acres)Prospective ResourcesIassFormationArea (acres)Gas (BCF)NGL (MMSTB)rospectLower Chonta Upper Nia Lower Nia6,671.872611.03









# Chaspa Prospect

			A.r.o.o.	Prospecti	ve Resources	
Name	Class	Formation	(acres)	Gas (BCF)	NGL (MMSTB)	Year
Chaspa	Prospect	Lower Chonta Upper Nia Lower Nia	8,648.69	1,056	16.1	HC 2017







# Loromayo Prospect

							8	250000	300000	350000	400000	450090	\$00000
	Class	Formation	Area	Pros Res	spective sources	Maar			-			-	
Name	Class	Formation	(acres)	Gas (BCF)	NGL (MMSTB)	Year		CARLES A CONTRACTOR	* 	MADRE	DE DIOS		ACTION OF A
Loromayo	Prospect	Lower Chonta Upper Nia Lower Nia	6,177.63	571	8.7	HC 2017	150000 B550000	cusco	r-	Second Second			BOLIVIA





## **Tabari West Prospect**



## **B6 Prospect**

ne	Class	Formation	Area	Pros Res	spective sources	Vear
ne -	Class	Pormation	(acres)	Gas (BCF)	NGL (MMSTB)	Tear
	Prospect	Upper Vivian Middle Vivian Lower Vivian Lower Chonta Upper Nia Middle Nia	9,637.1	2,841	152.0	Hunt Oi 2016 HC 2017







## Madre de Dios - Fold Thrust Belt Plays



#	Play	Plat Type	Тгар Туре
1	Pini Pini	Hinter Thrust	Anticline 3-4 way closure
2	Heath North	Frontal Thrust	Anticline 3-way closure Fault dependent
3	Heath South	Frontal Thrust	Anticline 4-way closure



## Historical 2D seismic of Camisea area, 2,602 km







#### Historical 3D seismic of the Camisea area, 2,563 km<sup>2</sup>

Historical 2D seismic of the Madre de Dios Folded Belt, 2,891 km





# Geoportal

# General, technical, infrastructure and cultural information

#### **GENERAL INFORMATION:**

- Blocks, Sedimentary Basins, fields, outcrops, "oil seeps", mineral collection, undrilled prospects.

#### **TECHNICAL INFORMATION:**

- Location of all the 2D and 3D seismic campaigns. Gravimetric and magnetometric campaigns. - Well locations.

#### **INFRASTRUCTURE INFORMATION:**

- North Peruvian pipeline, multi-product pipelines, gas pipelines, southern gas pipeline, platforms, batteries and other facilities.

#### **CULTURAL INFORMATION:**

- Native Communities (IBC). - Protected Natural Areas (SERNANP).

