History of Petroleum Exploration in Trinidad and Tobago*

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Abstract

Petroleum exploration in Trinidad and Tobago began in 1857 and was based on seeps, but currently uses sophisticated techniques like integrated basin analyses, petroleum systems concepts and 3D seismic. Initial prospecting based on seeps commenced in the 1850’s, and continued until 1905. During this phase, prospectors drilled on the basis of proximity to the pitch lake or oil seeps and found two fields which were never developed.

Prospecting on the basis of seeps gave way to a more scientific approach as geologists began to be employed. They did mapping to look for anticlines, armed only with the traditional geological tools of a hammer and compass/clinometer. On this basis, all the major land fields in Trinidad had been discovered by 1920. They have produced more than 1.5 billion barrels of oil to date.

The second oil province was discovered in 1954 by geologists who postulated extensions of land trends into the offshore. Together these offshore fields have produced over one billion barrels of oil. Exploration started off the East Coast of Trinidad in the late 1950’s. This resulted in the discovery of three giant oil fields and a series of large gas and condensate fields. 2D seismic was run in the late 1960’s followed by exploration drilling along the “Patao High” which resulted in the discovery of over 10 TCG.

Exploration entered a new phase in 1979 with the recognition of the Cretaceous age of the source, concepts of the plate tectonic history and geochemical studies which allowed integrated basin histories and the identification of eleven “petroleum systems”. Research from 1989 onwards resulted in the concept of evaporative fractionation of oil which successfully predicted deep residual oil. BPTT's recent (2013) 3D ocean bottom cable seismic revealed deep structures (below the shallow gas), which may hold deep black oil.

BHP Billiton discovered a major oil and gas field within the Central Range Transpressive Zone Lower Oligocene sands. The field has produced over 60 million barrels of oil to end of 2015. The exploration focus has turned recently to the ultra-deep waters off the East coast where BHP Billiton and BGTT ran the world's largest single 3D seismic survey in 2015.
Selected References


Persad, K., 2003, New Data on Trinidad Oils: Geol. Soc. Trinidad and Tobago.

HISTORY OF PETROLEUM EXPLORATION IN TRINIDAD AND TOBAGO

By

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AAPG ICE
Cancun Mexico
September 6-9 2016
CONTENTS

INTRODUCTION
EXPLORATION PHILOSOPHY
THE NINE EXPLORATION PHASES
INTRODUCTION

TRINIDAD AND TOBAGO IS LOCATED IN THE S.E. CORNER OF THE CARIBBEAN PLATE

Map altered from James 2003
INTRODUCTION

THE MAJOR BASINS ARE:
• THE TOBAGO FOREARC BASIN
• THE COLUMBUS FOREDEEP BASIN AND
• THE LOWER TERTIARY FOLD AND THUST BELT OVERLAIN BY
• THE GULF OF PARIA (PULL APART) BASIN AND THE SOUTHERN (PIGGY-BACK) BASIN AND
• THE ACCRETIONARY PRISM WITH A TOE-THRUST BELT TO THE EAST

Map altered from Pindell 1991

AAPG ICE
Cancun Mexico
September 6-9 2016
INTRODUCTION

PETROLEUM EXPLORATION STARTED IN 1857 AND CONTINUES TODAY

TO DATE THERE HAVE BEEN EIGHT EXPLORATION PHASES RESULTING IN THE DISCOVERY OF THREE OIL PROVINCES AND TWO GAS PROVINCES WITH CUMULATIVE OIL PRODUCTION OF OVER 3.5 BILLION BARRELS OIL AND OVER 12 TCF GAS

A NINTH EXPLORATION PHASE WITH HUGE POTENTIAL IS JUST STARTING IN ULTRA-DEEP WATERS
OIL & GAS PROVINCES

Map altered from Persad 2003
INTRODUCTION

THREE OIL PROVINCES:

• LAND
• GULF OF PARIA
• EAST COAST MARINE AREA

• PEAK OIL (1978): 228,000 BOPD
• CURRENT (Q1 2016): 74,700 BOPD
• CUMULATIVE OIL PRODUCTION OVER 3.5 BILLION BARRELS
INTRODUCTION

TWO GAS PROVINCES:
• EAST COAST MARINE AREA
• NORTH COAST MARINE AREA

• GAS PRODUCTION PEAKED 2009 at 4.564 BCFGD
• Q1 2016 PRODUCTION IS 3.6 BCFD, WITH 435 MMCFGD FROM THE NCMA
• CUMULATIVE GAS PRODUCTION OVER 12 TCF GAS
This phase of exploration commenced in the 1850s and continued until 1905. During this phase, prospectors with no formal training, drilled on the basis of proximity to the Pitch Lake or oil seeps. The concept was simple.... Look for oil where you know it to exist. The tools were equally simple... follow the seeps. The early drilling included a well in 1857 at the Pitch Lake by Merrimac, and wells by Walter Darwent at Aripero in 1867. All found oil. Darwent’s death soon after resulted in a 35 year hiatus.
EXPLORATION PHILOSOPHY PHASE ONE

Randolf Rust and John Lee Lum started exploring for oil also on the basis of seeps in 1898. By 1905 they had discovered what is now called Beach Field in Guayaguayare (cumulative to date over 90 MMBO), rehabilitated Darwent’s original Aripero wells and drilled new wells.
EXPLORATION PHILOSOPHY  PHASE TWO

Geological Mapping looking for Anticlines

Prospecting on the basis of seeps gave way to a more scientific approach as geologists entered the picture.

They did field mapping to look for anticlines, armed only with the traditional geological tools of a hammer and compass/clinometer. Due to the thick vegetation outcrops were scarce, as such 9’ deep trenches were dug to create exposures also holes were augured and the cuttings examined.
Between 1905-1907 Cunningham-Craig, a Government geologist mapped the entire southern Trinidad and identified a number of prospective areas on the basis of anticlines and oil seeps. Using this data the Government leased a swath of land acreage to a number of mainly start-up companies.
EXPLORATION PHILOSOPHY

PHASE TWO

DISCOVERY OF THE LAND PROVINCE
Within 10 years virtually all the major land fields in Trinidad had been discovered. The land fields of this first petroleum province have produced over 1.5 billion barrels of oil by the end of 2015. Most of this came from these early discoveries or deeper pools found later. Current LAND production (Q1 2016) is 21,074 bopd

<table>
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<th>FIELD NAME</th>
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<tr>
<td>Forest Reserve</td>
<td>1914</td>
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<td>Fyzabad</td>
<td>1918</td>
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Fyzabad Exploration well 1918 (Besson 2014)
EXPLORATION PHILOSOPHY PHASE THREE
Conceptual Thinking (Trendology) and Technology (Seismic)...

DISCOVERY OF THE GULF OF PARIA PROVINCE
The second oil province was discovered in 1954 by astute geological thinking by the geologists of the day like C.C. Wilson, who using 2D seismic, extrapolated the Los Bajos Fault off-shore and correlated the Soldado Anticline offshore as the unmoved portion of the prolific Pt. Fortin Anticline onshore

Modified from Robertson Research 1984
DISCOVERY OF THE GULF OF PARIA PROVINCE

The first well High Seas One was the discovery well of the Soldado Main Field. Within five years two other large fields were discovered... East Soldado and North Soldado. Other fields have found since then.

To the present the Gulf of Paria fields have produced over one billion barrels of oil and current production (Q1 2016) is 21,335 bopd.

Modified from Robertson Research 1984
EXPLORATION PHILOSOPHY

PHASE FOUR

Conceptual Thinking Trendology)
and Technology (Seismic)...II

DISCOVERY OF THE EAST COAST OIL AND GAS PROVINCES
The third oil province was discovered using the same exploration philosophy as was used in Phase Three
Dominion Oil and then PanAmerican (Amoco) drilled a series of wells starting in 1961, on anticlines along trend with those onshore where major discoveries had been made.
DISCOVERY OF THE EAST COAST OIL AND GAS PROVINCES

Within 10 years (by 1971) three giant oilfields, Teak, Samaan and Poui and several giant gas fields were discovered.

Together these and later discoveries have produced over one billion barrels of oil and condensate and over ten trillion cubic feet of gas.

Q1 2016 ECMA production is 32,291 bpd of oil and condensate and 3.6 bcfgd.
EXPLORATION PHILOSOPHY PHASE FIVE

Offshore 2D seismic

DISCOVERY OF THE NORTH COAST MARINE AREA (NCMA) GAS PROVINCE

The second gas province was discovered using for the first time direct hydrocarbon detection. 2D lines run in the NCMA in 1968 with United Nations funding showed distinct bright spots on structures along the Patao High. Within 5 years the Hibiscus, Pointsettia, Chaconia, Orchid and Iris fields had been discovered along the crest of the Patao High. Other fields have found further east along trend since then using 3D seismic.
EXPLORATION PHILOSOPHY

PHASE FIVE

Direct Hydrocarbon Detection

DISCOVERY OF THE NORTH COAST MARINE AREA (NCMA) GAS PROVINCE

The Hibiscus Complex (comprising Hibiscus, Ixora, Pointsettia and Chaconia) came on production in 2004 at 450 MMCFGD and 50 BCD. Current production is 435 MMCFGD and 50 BCD.

Map altered from Persad 2003
IN THE MID 1990's BHP BILLITON (OPERATOR) AND PARTNERS ACQUIRED OBC SEISMIC AND DISCOVERED THE LARGE ANGOSTURA FIELD COMPLEX IN AN OFFSHORE EXTENSION OF THE FOLD AND THRUST BELT ...GAS WITH AN OIL LEG

The Angostura field came on production in 2005 and has since produced about 60 million barrels of oil to end 2015 and in Q1 2016 still producing 6,500 bopd and 379 MMCFGD, of which sales are about 252 MMCFGD.
EXPLORATION PHILOSOPHY 
EVAPORATIVE FRACTIONATION

DISCOVERY OF DEEPER POOLS

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EXPLORATION PHILOSOPHY PHASE SEVEN
EVAPORATIVE FRACTIONATION

DISCOVERY OF DEEPER POOLS

DEEPER THIN OIL LEGS HAVE SINCE BEEN DISCOVERED IN MAHOGANY AND AMHERSTIA/IMMORTELLE FIELDS IN THE ECMA AND DEEP (CRUSE) OIL HAS BEEN DISCOVERED IN THE SOUTHWEST PENINSULA ONSHORE
EXPLORATION PHILOSOPHY PHASE EIGHT

OBC SEISMIC

DISCOVERY OF DEEPER POOLS IN THE ECMA

BP USED NEW GENERATION OBC SEISMIC IN 2013 TO SEE BELOW THE SHALLOW GAS IN THEIR ECMA FIELDS AND HAVE DISCOVERED DEEPER GAS AND CONDENSATE IN THE SAVONETTE FIELD AND PLAN TO DEVELOP THE ANGELIN FIELD
EXPLORATION PHILOSOPHY PHASE NINE
DEEP WATER EXPLORATION

EXPLORATION IN THE DEEP AND ULTRA-DEEP WATER AREAS HAS STARTED
BHP BILLITON RECENTLY RAN THE LARGEST 3D SEISMIC PROGRAMME IN THE WORLD...+/− 24,000 sq. kms.
EXPLORATION PHILOSOPHY
DEEP WATER EXPLORATION

EXPLORATION IN THE DEEP AND ULTRA-DEEP WATER AREAS HAS STARTED

BHP BILLITON HAS NOW STARTED EXPLORATION DRILLING LE CLERC 1 (completed drilling) AND BURROKEET 1

HUGE POTENTIAL...OIL AND GAS