Shell, Texaco and Occidental - Pioneers in the Exploration in Putumayo, Oriente and Marañón Basins*

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Abstract

The Putumayo-Oriente and Marañón Basins in Colombia, Ecuador and Peru are located in a foreland zone between the Andes to the west and the Guyana shield on the east. It covers about 320,000 km². Over 3 Billion barrels of oil (BBO) and 1,000 billion cubic feet of gas (BCFG) have been produced from the Putumayo-Oriente and Marañón Basins. Estimated undiscovered recoverable resources range from 1,000 to 7,000 BBO and 250 to 5,000 BCFG. The main hydrocarbon reservoirs in the Putumayo Basin in Colombia are the Cretaceous Caballos and Villeta and the Tertiary Pepino Formations. Oil is produced in the Oriente Basin of Ecuador mostly from sandstones of the Cretaceous Hollin and Napo Formations. In Peru's Maranon Basin, the reservoirs are sandstones of the Cretaceous Cushabatay, Agua Caliente, Chonta and Vivian Formations. Oil exploration in the Putumayo-Oriente and Marañón Basins started in 1921. The first discovery is Orito, in 1963, in the Putumayo by Texaco. The Oriente Basin has been intensively explored since the early 1930s. Shell first explored for oil in the Oriente Basin of Ecuador in the 40's mainly using field geology. Because of these efforts, three wells were drilled, Macuma, Pumbuiza and Tiputini, all three abandoned with only oil shows. Following the string of discoveries in the Putumayo Basin by Texaco in the 1960's, and interpreting the petroleum geology to continue down to the south into Ecuador and after negotiating with the government of Ecuador in the early 1960's for exploration acreage, Texaco undertook a large field geology campaign in the Oriente Basin of Ecuador, followed by 2D seismic. In April 1967, Texaco drilled the first exploration well, Lago Agrio # 1, a subtle structure in the foreland basin. The well TD into the top of the Pre-Cretaceous Chapiza Formation. The well tested 1,399 Bopd, 29.30 API from the Cretaceous Hollin Formation. This was the start of the modern oil industry in Ecuador. The Oriente basin of Ecuador contains the largest discovery to date in the Putumayo-Oriente-Maranon basins, the Shushufindi field, discovered by Texaco in 1970, with an estimated 3.5 BBO in place. The Marañón Basin of Peru was first explored for oil in the 1930s and 1950s. The first commercial discoveries in the basin were made by Occidental and PetroPeru in 1972.

Selected Reference

Shell, Texaco and Occidental
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Special Session
Giant Oil Field County (in Ecuador)

More than 3 BBO and 1 TCFG produced to date from the Putumayo (Colombia), Oriente (Ecuador) and Maranon (Peru) basins. Ecuador is the sweet spot.

Estimated prospective resources (undiscovered recoverable resources) vary from 1,000 BBO to over 5,000 BBO and 200 to 4,000 BCFG.

Major reservoirs.

**Putumayo:** Cretaceous Caballos and Villeta Formation and Lower Tertiary Pepino Formations.

**Oriente:** Cretaceous Hollin and Napo Formations.

**Marañón:** Cushabatay, Agua Caliente, Chonta, and Vivian Formations.
Regional Geological Setting, Basins Location, Strat Column

After USGS Digital Series Paper # 63 (Modified)
Putumayo, Oriente, Marañón Basins, West-East Well Log Correlation

A Limestone  B Limestone  C Limestone

Orito

Pepino Sst. (=Tena)

Lower Villeta (Colombia) = Napo (Ecuador) = Chonta/Agua Caliente/Raya (Peru)

Lo Villeta Sandstones In Colombia U and T Sandstones in Ecuador Chonta and Aquacaliente Sandstones (Peru)
PETROLEUM SYSTEM ELEMENTS 1.
Putumayo, Oriente, Marañón Basins

- Structural-stratigraphic accumulations, some very subtle.
- Main reservoirs are the fluvial/estuarine channel fills and nearshore marine environments of the Napo U an T in the Putumayo and Oriente and its counterpart, the Vivian sandstone in Marañón.
- Depths to the reservoirs ranges from 30 to 15,000 ft.
- Thickness: Napo-Villeta varies with average of 300 meters and up to 900 meters. Porosity: average 17% with up to 25% and Permeability 500 MD with up to 6,000 MD.
PETROLEUM SYSTEM ELEMENTS 2. Putumayo, Oriente, Marañón Basins

• Source Rocks are the Cretaceous Villeta, Napo, Chonta Shales

• Seals are the Upper Cretaceous-Lower Tertiary Shale

• Thick sandstones of Caballos/Hollin/Cushabatay---major pathway of oil migration from downward expulsion from shallower rich source rocks.
Petroleum Systems Event Table, Putumayo, Oriente, Marañón Basins

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**QUAT.**

**Petroleum System Events**

1. **Pepino, Basal Tena Sst.**

2. **Critical Moment**

3. **After Mathalone and Montoya, 1995**
Exploration History, Putumayo, Oriente, Marañón Basins

- Exploration in the Putumayo Basin was initiated in the late 1950s. First listed discovery was by Texaco in Orito (1963).
- Exploration in the Oriente Basin began with Shell’s pioneering work. All Shell office stranded in Ecuador in WWII, had no where to go, performed extensive outcrop and drainage analysis studies, built a town, airport, road.
- The first discovery in the Oriente Basin by Texaco was Lago Agrio in 1967. Giant field, with hydrodynamics (tilted water contact, common in this megabasin)
- In the Marañón, exploration started in the late 1960s (Texaco, Mobil). First economic discovery was by Occidental in the 1970s---cluster. Union discovered 3 fields in adjacent acreage, sub-economic without Oxy’s cluster. Dropped acreage, Oxy produced the heavy oil, co-mingled with their lighter crude.
The first discovery in the Oriente Basin by Texaco was Lago Agrio in 1967. This was followed by a string of discoveries by Texaco, including, Shushufindi-Aguarico, the largest field in 1969, with 3.5 BBO in-place, followed by Sacha and Auca.
Seismic Acquisition, Oriente Basin
Oriente Basin, Well Lago Agrio #1, Texaco, Completed 04-08-1967
Northern Maranon Basin

1. Oxy/Union Blocks acquired based on regional gravity data & drainage
2. Oxy’s geoscience team came from experienced Texaco geoscientists, lawsuit ensued
3. Built pipeline, first significant oil in Maranon, boost to Peru’s economy
Pathfinding Exploration Companies
We used to hike along the thin swaths from seismic acquisition where drilling for Tenneco or Unocal was very slow. Watching out for snakes, spiders, black jaguars and wankas (wild turkeys).
Second Tier Companies Which Discovered Oil in Order of BBO

Economic Resources total
> 150 BBO EUR

Subeconomic Resources total
< 150 BBO EUR

Operator

PETROPERU
CONOCO
ORYX
AEOL
TENNECO
SUPERIOR PRODUCTS
STANDARD
UNION 76
Pathfinding explorers: Shell

Foothills discoveries by Texaco, Shell, Burmah and others discovered based on excellent field work and regional geology

Peruvian and Colombian parts of this mega basin appear quite maturely explored

Ecuador: first company into the basin, Shell, did not find the giant oil fields
Conclusions 1

Paleozoic plays have been tested (Lago Agrio Deep Test-1) and a few other wells, but reservoirs were tight.

Robust hydrocarbon charge system: very rich source rocks, good to excellent reservoirs.

Considerable potential exists within Ecuador.

Following the Path of the Oil Finders is not only fun, but important to any initial regional evaluation of a basin.
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