Structural / Stratigraphic Model

Schematic Cross-Section
CENTRAL REGION

Schematic Cross-Section
ALONG CENTRAL REGION
**Organic Matter Type**

**VAN KRAVELEN MODIFIED DIAGRAM**
(IRO FM - CENTRAL REGION)

**VAN KRAVELEN DIAGRAM**
MONTEREY FM.- POINT ARGUELLO FIELD

**Reservoir Quality**

La Mojarra Fm.
Conglomerates and coarse sandstone

Iro Fm.
Mudstones and shales interbedded.

QM-I-003 Iro Fm.
Sandstones lithic fine grain section is open, interstitial matrix, decreasing the primary porosity 6%.

QM-I-003 Iro Fm.
Mudstone, micrite mainly. One of the three fracture directions is open, increasing the quality reservoir porosity 6%.
Petroleum System

**Sources:** All the hydrocarbon (shales) found in the Pacific Basin are believed to have been generated primarily within the Ito Formation (geochemical analyses).

The total organic carbon (TOC) content of the Ito Formation ranks from very good to excellent. Three condensed sections (CS) were analyzed. SC1 consists of a phosphatic shale with a thickness of 150 feet and TOC content between 4.3 and 24%, SC2 consists of a highly organic phosphatic shale with a thickness of 110 feet and TOC content between 2 and 14.6%, kerogen type II and hydrogen index of 340 to 540 (mg HC/gt. rock). CS3 consists of highly bituminous shale with a thickness of 190 feet and TOC content between 1.5 and 11.0%, kerogen type I and II, and hydrogen index of 161 to 523 mg (HC/gt. rock). These condensed sections are excellent oil prone. In addition, cherts and shales from Iro Fm. with an average TOC of 3% are also potential sources.

**Reservoirs:** Carbonate and siliciclastic rocks from Ito and La Mojara formations (Middle Miocene) are the major potential reservoir rocks. Naturally fractured cherts, abundant in the basin, could be an important reservoir as seen in the Point Arguello oil field in Southern California (Analog example).

**Traps:** Several basement structural highs, mud-diapir core anticlines, diapir flanks, thrust anticlines, normal fault rollover, stratigraphic geometries, and highly fractured carbonates and cherts along fault zones, are all potential traps.

**Seals:** Seal units occur throughout the sedimentary column, represented by clay units. These units are homogeneous, laterally continuous, with excellent ductile properties. The Sierra Formation (Oligocene) and Ismina Formation (Lower Miocene) are regional seals.

**Generation and Migration:** Any oil generated must have migrated laterally up dip to the flanks of structures. Long distance laterally migration of hydrocarbons is suggested on the basis of geochemical and stratigraphic and structural data. Vertically migration pathways are associated to fault systems. Critical moment occurs after deposition of sealing units about 5 Ma. and migration continues up to date.
Prospectivity

In terms of wildcat density the basin is unexplored. Limited data are available for the pacific offshore and therefore a detailed level of assessment in not possible. Geochemical data indicate the existence of the Iro-Mojarra(? petroleum system. Very high TOC content ranging from 4-24%, kerogene type II and III and hydrogen Index ranging 370-700 mgHC/g rock indicate an excellent oil prone source rock.

Oil generated has migrated and is probable been trapped in large mud-core anticlines, rollovers associated to Listric Normal Faults, and large high-side closure in fault propagation folds, mostly south of Tambora-1 well. Large thrust-related anticlines together with numerous stratigraphic and traps place this basin as a prime exploration target.
Basin Location:

The Pacific Basin covers about 103,000 km². Up to date 14 wells have been drilled, with a coverage of 7,360 km²/well in the basin, a density much less than other basins in Colombia. Surface indications for oil and gas have been reported in numerous locations. Subsurface shows of oil and gas were encountered in the Buchado-1, Chagui-1 and Maiagua-1 wells.

HIGHLIGHTS

◆ ANH Pacific Projects 2005-2006

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Phase 2 Backstering and heat flow program
Piston core program (Geochemical evaluation)
Areas of Interest
Stratigraphic well
3D-Seismic
Leads/Plays

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The Pacifico Basin project will be carried out in western Colombia and will cover a combined area of over 115,100 square kilometers. The main focus of the project has been drilling in the basin, much lower density than in other basins of Colombia. Surface indications for oil and gas have been reported in numerous locations. Seabed shark shows of oil and gas were encountered in the Bacucho-1, Chaguar-1 and Cipialago-1 wells.

Source: All the hydrocarbons (shale) found in the Pacifico Basin are believed to have been generated primarily within the triple-fissionation, on the basis of geophysical and geochemical analysis.

The total organic carbon (TOC) content of all the formation rocks is very good to excellent. Three combined sections (CCS) were analyzed. SCC consists of a hydrophatic shale with a thickness of 110 feet and TOC content between 4.5 and 20 percent. SCC consists of highly organic phosphatic shale with a thickness of 110 feet and TOC content between 4.5 and 12 percent. SCC consists of highly organic limestone and shale with a thickness of 200 feet and TOC content between 5.5 and 13 percent, dominated by siliciclastic material. Hydrogen index of 50 to 145 mg HC/g rock. Excellent oil-prone.

Reservoir: The average TOC of the shale and shaly parts of the formation is over 5 percent. Carapaces and drusy calcite of the Iron and La Virgen formations (Mau- dite Mississippian) are the most potential reservoir rocks. As an analog, naturally fractured shale facies abundant in the basin, would be a very important reservoir if it happens in the Point Arguello oil field of Southern California.

Type: Several framework structural highs, most dip into southeast, steep dips, steep anticlines, normal fault valleys, stratigraphic pinchouts, and highly faulted outcrops and cherts along fault zones, are all potential traps.

Residual: Highs occur throughout the carbonate section, represented by key units. These sections are conformable, laterally continuous, with excellent shale properties. The Bucar formation (Upper Permian) and Calima formation (Lower Mississippian) are regional seals.

Generation and Migration: Any generated oil most have migrated laterally up dip to the flanks of the structure. Lateral migration distances are not based on a relationship of geohistory and stratigraphic structure. Vertical migration pathways are associated to salt systems. Critical moments occur after deposition of sealing units about 3.5 mile (5.6 km) and migration continues up to date.

Summary of Hydrocarbon Elements