

# COLOMBIA:



Photo: Fredrik von Zernichow

InterOil Colombia Oil & Gas has just completed Mana #7 on the Mana license in the Upper Magdalena Valley as a producer.

# Moving Out of the Shadows

The announcement of a new licensing round in Colombia emphasises how the South American country is moving out of the shadow of violence and into a new era of stability and growth. Billions of barrels of oil may be found according to optimistic geologists.

Jane Whaley, Associate Editor

For many years, political instability and the threat of internal violence and terrorism meant that few international oil companies could be induced to include Colombia in their exploration portfolio. For the past decade, however, the country has progressively become a safer and more stable place, and the main hurdle the Colombians now find they have to face is an underestimation of the high level of hydrocarbon prospectivity the country can offer.

## Claiming significant potential

According to ANH (Agencia Nacional de Hidrocarburos, the Colombian authority responsible for the administration of hydrocarbon resources), this view is as inaccurate as the perceptions about personal safety. "Colombia became a net oil exporter in the 1980's and oil production peaked at 687 Mbopd in 2000. There has been slow but steady growth since 2005, and production

is now up to 557 Mbopd, with over 730 MMcfcpd (130 Mboepd)," explains Armando Zamora, Director General of ANH. Mr. Zamorro was speaking at the recent series of presentations organised by ANH, aimed at encourage companies to invest in the latest acreage round in Colombia.

"Licensing activity is also increasing, bringing with it record levels of foreign investment," Zamorro said.

"The proven oil reserves of Colombia are estimated to be 1.8 Bbo, while its natural gas reserves are in the region of 7.5 Tcf (1.35 Bboe)," he continued. "Oil represents 27% of the country's exports and our strategic position between North and South America is very important. We even export gas to our major gas producing neighbour, Venezuela."

Yet Ecopetrol, the State oil company, estimates that the potential reserves of the country could be significantly (!) higher, possibly in the order of 47 Bboe. (In comparison, Venezuela's proven oil reserves are



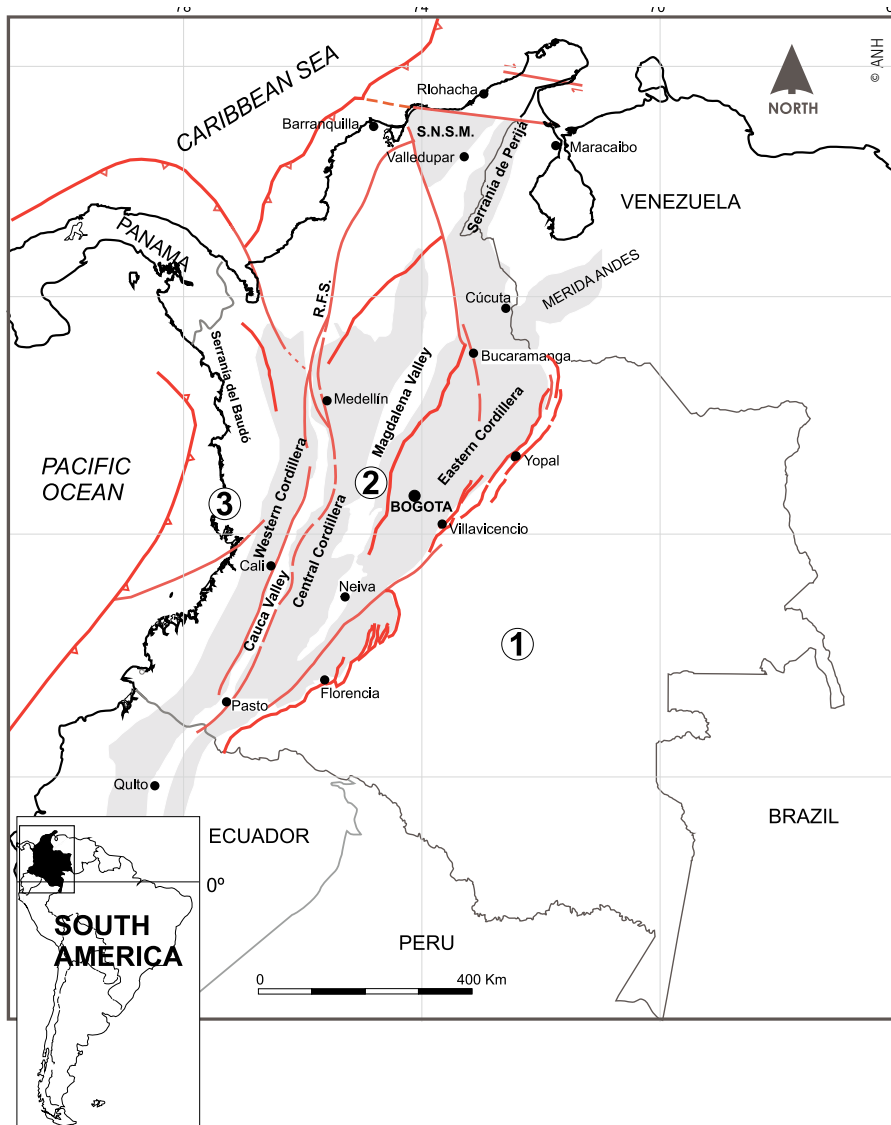
## Colombia

The Republic of Colombia is located in the north-western corner of South America. It is the only South American country bordering both the Pacific and the Atlantic Ocean. Colombia's diverse topography produces a variety of climates, ranging from hot and humid to perpetual snows. In general, the coastal and Amazonian areas are warm and tropical, while the mountainous terrain in the centre of the country is cool throughout the year. Colombia covers an area of 1.14 million km<sup>2</sup> (Texas is 690,000 km<sup>2</sup>), and the territory divided into four major geographic regions: Andean highlands (composed of three mountain ranges – *cordilleras* – and intervening valley lowlands); Caribbean lowlands; Pacific lowlands; and Llanos and tropical rainforest of eastern Colombia. The population was almost 42 million in 2005, with 75% concentrated in urban centres. The official language is Spanish but English is widely used in business circles.



Armando Zamora, Director General, with colleagues from the Colombian ANH introducing their latest licensing round.

# COUNTRY PROFILE: COLOMBIA



Colombia exhibits three major onshore domains: The Western Region, The Central Region and the Eastern Region.

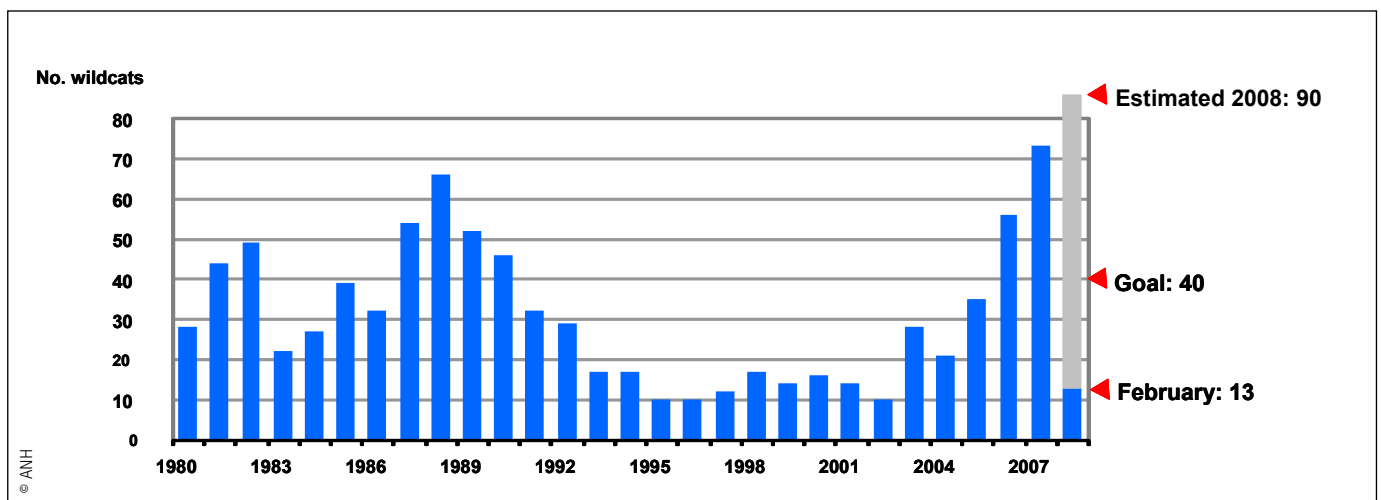
in the order of 80 Bbo, according to BP Statistical review of World Energy, 2007). At this stage, it is therefore wise to be careful when using this rather optimistic estimate made by Ecopetrol.

For the moment, Colombia remains relatively untouched and a large percentage of its territory, both on- and offshore, is unexplored. In other words, there should be plenty of opportunities for the innovative and persistent petroleum explorationist.

## Crime and Terrorism Reduced

To alleviate any outstanding worries about personal safety and security of hydrocarbon operations in Colombia, Hector Manosalva, Advisor on Protection of Energy Infrastructure to the President, pointed out at the meeting that the number of terrorist attacks in the country had dropped dramatically over the past 5 years, as had the incidence of homicides and kidnapping. In fact, as Mr. Manosalva pointed out, "the level of homicides per head of population in Colombia is now the lowest in South America, and much lower than found in many US cities." The majority of attacks which still occurred were in the border regions with Venezuela and Ecuador, where the government has recently set up a special protection force to ensure security.

Importantly, the last 5 years has seen an 80% drop in the production of coca, resulting in a significant drying up of funds to illegal drug trafficking organisations and a reduction in organised crime. As a result, the confidence of the population in the long term future of their economy has



Recent investment in Colombia has seen a major upsurge in the drilling of exploratory wells, with a success rate in 2007 of about 40%.

increased dramatically, and the overall risk factor of Colombia is rated lower than a number of its neighbours, including Argentina and Ecuador.

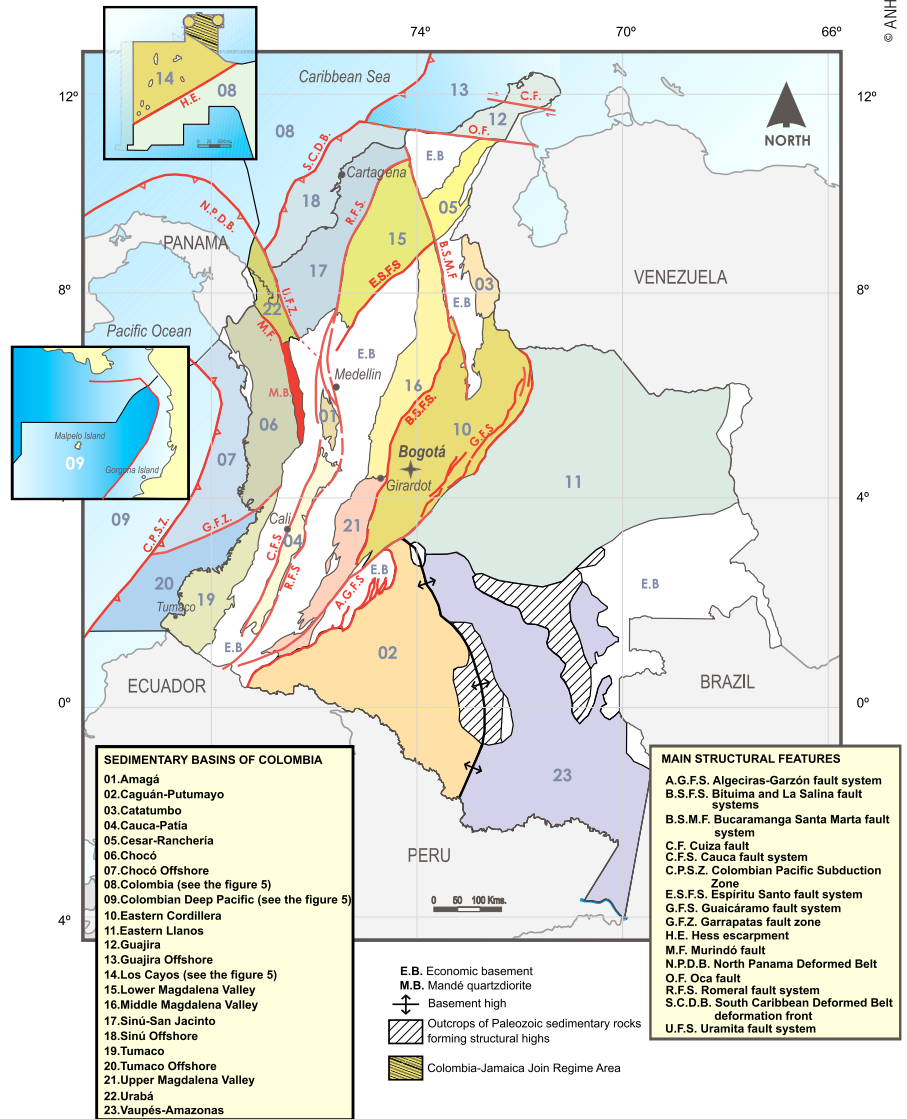
### Three Tectonic Domains

From Paleozoic to Late Cainozoic, the basins of Colombia have undergone rifting and oblique collisions followed by transpression and transtensional tectonic deformation. As a consequence, the tectonic evolution of most, if not all Colombian basins, is complex.

Colombia exhibits three major onshore domains. The Eastern domain, by far the largest, is limited on the west by the foothills of the Andean Eastern Cordillera, and consists of a Precambrian and Palaeozoic basement with a mildly deformed sedimentary cover of Mesozoic-Cainozoic age.

By contrast the Central domain, which extends through the centre of the country from the Eastern to the Central Cordillera along the Magdalena River, extending as far as the Romeral fault (RFL) system to the west (compare map), has a cover of sedimentary and metamorphic rocks on a Palaeozoic basement.

The Western domain, to the west of the Romeral fault system, and extending into both the Pacific and Caribbean oceans, is composed of Mesozoic to Cenozoic oceanic terranes accreted onto the Continental margin during the Late Cretaceous and Tertiary.



ANH has divided the country into 23 sedimentary basins.



Heavy oil well in the Middle Magdalena Valley".

## ANH

The ANH (Agencia Nacional de Hidrocarburos) is the agency “responsible for promoting the optimal exploitation of the country’s hydrocarbons resources, by managing them integrally and finding a balance between the interests of the State, Colombian society and companies operating in the sector.”

The ANH will be recognized as “a world model institution because of 1) its knowledge of the Colombian sub-surface potential and the maximization of its exploitation, 2) the efficiency in the management of hydrocarbons and the joint work with both industry and the community, and 3) the professionalism of its team, a high technological level and its efficiency and flexibility in key processes”.

The ANH has recently presented a new nomenclature and borders of some of the sedimentary basins in Colombia before the national and international geological community. Altogether 23 basins have been defined, including the Colombia Basin in the deep Caribbean to the north and the Deep Colombian Pacific Basin to the west of the subduction zone of the Pacific Ocean.

[www.anh.gov.co](http://www.anh.gov.co)

The country has been divided by ANH into 23 basins, most of which developed in the Late Triassic during the break-up of the super-continent of Pangea. After this event, the central and eastern basins experienced widespread subsidence, resulting in the deposition of marine sediments, including the Late Cretaceous La Luna shale, which is responsible for generating most of the hydrocarbons found in Colombia. As the Central and Eastern Cordilleras rose in the Late Cretaceous and Early Tertiary, the depositional environment changed from marine to continental, giving rise to the fluvial deposits which form many of Colombia's hydrocarbon reservoirs.

By contrast, the geology of the basins to the west of the Western Cordillera, stretching into the Pacific and the Caribbean, is composed of complex, highly deformed

igneous rocks with Mesozoic deepwater shales and turbidites. The Nazca Plate, which underlies most of the south-eastern Pacific, is being subducted beneath most of the west coast of South America at a rapid rate of 80 to 100 millimetres per year. In the north, the Caribbean plate is also being subducted beneath South America. The hydrocarbon potential, if any, of this western region is poorly understood.

Lower Palaeozoic marine and coastal siliciclastic and carbonate sediments are distributed throughout the Eastern region and extend into the Central region. In some places, the thermal maturity of these Lower Palaeozoic sequences indicates appropriate conditions for hydrocarbon generation.

## Large Fields

By far the majority of hydrocarbons found

in Colombia come from the Central and Eastern domains.

The first discoveries were made during the 1920's and 1930's in the Magdalena Valley, which runs from south to north through the country, flanked by the Eastern and Central Cordillera. The Middle Magdalena Valley is one of the most explored in Colombia, having produced nearly 2 Bbo of oil so far, and there is also good production in the Upper Magdalena Valley to the south.

South-east of the Magdalena Valley is the Caguán-Putumayo Basin, which forms the ►

The pre-Cretaceous Sierra Nevada de Santa Marta mountains border the Cesar Rancheria Basin in the very north of Colombia. Over 12,000km<sup>2</sup> of frontier acreage is offered by the Colombian government in this basin, which is thought to have potential for the discovery of oil, gas and coal bed methane.

## La Luna Source Rock

In the Late Cretaceous, warm oceanic deep waters with low dissolved-oxygen contents, together with poor oceanic circulation in tectonically restricted basins, and elevated levels of marine productivity, led to an event which has had major economic consequences for the modern world. This was the deposition of organic rich sediments, often referred to as 'black shales', in many of the oceans of the world.

These deposits include the Upper Cretaceous (Cenomanian to Santonian) organic rich La Luna and equivalent formations, which are widespread across much of South America. They form the main source rock in Venezuela in the Maracaibo Basin, one of the most prolific hydrocarbon basins in the world, and are also the main source rock in the Magdalena Valley, and much of the rest of Colombia.

Shallow water carbonate sedimentation ended in the late Early Cretaceous (Albian) with a marine transgression which allowed the accumulation the La Luna Formation. This is a thick sequence of dark brown to black laminated shales with fine grained bituminous limestones and chert, with an organic carbon content as high as 10%, predominantly marine algae. It was deposited in a shelf-to-slope environment under anoxic conditions and modified by intermittent oxygenated periods and tectonic events.



Heavy oil sourced from the La Luna Formation in the Magdalena Valley. The oils usually have a moderately light gravity of about 25° API, but this can be reduced to 12° API by biodegradation and water washing.

northern extension to the prolific Oriente Basin of Ecuador and Peru. Reserves of more than 365 MMbo have been found here, including the Orito field, which has operated for more than 35 years, and had an estimated 250 MMb recoverable oil. Most discoveries have been in fault-related structural traps.

Some of the largest fields in Colombia have been found in the Eastern Cordillera, where the capital, Bogota, is situated, between the Magdalena River Valley and the Eastern Llanos Basin. A system of half-graben basins, filled with marine deposits, forms good structural traps, and a number of large accumulations have been discovered, including the giant (i.e. > 500 MMboe) BP operated (Ecopetrol own 50%) Cusiana and Cupiagua fields, as well as a large gas-condensate discovery. ANH suggest that interesting potential plays, including salt domes and non-conventional gas plays, remain unexplored.

## More Opportunities

By contrast, only limited reserves have been identified in the Lower Magdalena Valley and adjacent Sinú-San Jacinto Basin in the north-west of the country, although seeps indicate that a petroleum system is in place. To encourage exploration, ANH is offering 10 blocks covering about 22,280 km<sup>2</sup> over the northern part of the two basins, and believe that there is potential for gas as well as oil in the area.

A further 12,500 km<sup>2</sup> is available through the 2008 Licensing Round in the extreme



Colombia is a beautiful country, spanning the link to Central America, facing both the Atlantic and the Pacific Oceans and traversed by snow-capped Andean mountain ranges. One of Colombia's many National Parks, Parque Tatama, is in the coffee growing region on the eastern edge of the Choco Basin, due west of Medellin, where exploration for hydrocarbons has scarcely begun.

## The Andes

The Andes form the world's longest exposed mountain range. As much as 7,000 km long and up to 500 km wide, it lies as a continuous chain along the western coast of South America. The highest mountain in the Andes is Aconcagua (6962m) in Argentina. In Colombia, the Andes splits into 3 cordilleras (mountain ranges), the western, central and eastern.

### Western Cordillera (Cordillera Occidental)

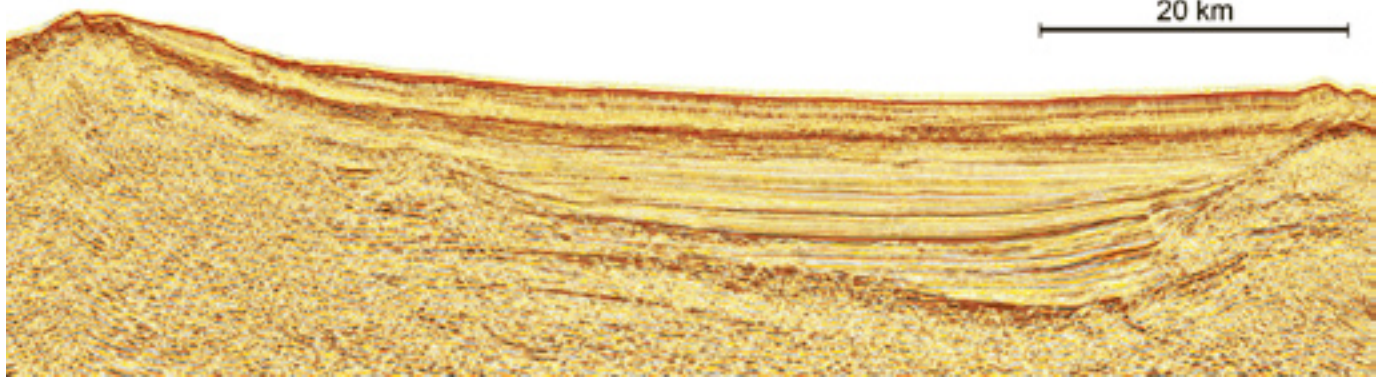
The non-volcanic Western Cordillera forms the barrier between the Cauca valley and the rain-drenched Pacific coast. The western part thus belongs to the Pacific region. It is the lowest and least populated of the 3 ranges.

### Central Cordillera (Cordillera Central)

The Cordillera Central is the highest of the Andean ranges of Colombia, rising to an average height of 3,000 metres. The range is bounded by the Cauca and Magdalena river valleys to the west and east, respectively.

### Eastern Cordillera (Cordillera Oriental)

This rugged and wet tropical region is located on the eastern slopes of the Andes, extending from northern Peru, through Ecuador and into southern Colombia. The altitude ranges from 900m to more than 2100m.



© Wavefield-Inseis

Section through the Los Cayos Basin in over 1,000m water depth in the Colombian Caribbean. This is part of the deepwater offshore Caribbean which has not yet been explored. The data is from a 3,863 km long offset multi client seismic survey acquired by Wavefield Inseis in 2006.

north of Colombia in the Cesar Ranchería and Guajira Basins. Ten blocks are offered in this frontier area, which has only a few wells and no production, but is thought to be an extension of the Venezuelan Maracaibo Basin. It appears to contain a Cretaceous petroleum system sourced from the La Luna shales, and ANH estimates suggest that as much as 4 Bboe reserves of both conventional and non-conventional hydrocarbons (heavy oil) may be found.

The Catatumbo Basin, a south-west extension of the Maracaibo Basin, has been successfully exploited, but the area to the south of it in the north-eastern corner of the Eastern Cordillera Basin is underexplored. The 2008 Round includes 12,439 km<sup>2</sup> here, where there are a number of seeps and single well discoveries, and hydrocarbons may include heavy oil.

Heavy oil, a major resource across the border in Venezuela, is of increasing importance, particularly in the Eastern Llanos Basin in the north-east of Colombia. Cumulative production from this basin is nearly 3 Bbo, 24% of which is heavy oil, with 3 major producing fields, Castilla, Rubiales and El Miedo. The Colombian Government is offering 17 blocks, totalling 29,600 km<sup>2</sup>, for heavy oil exploration in the south-western part of the Llanos Basin, where plays involve both structural and stratigraphic traps, particularly pinch-outs as sediments thin to the east. A number of leads have been identified and, according to a study by Halliburton, reserves for the basin have been estimated at 124 MMbo in place (P2).

## Offshore Gas Fields

About 20% of Colombia's total sedimentary basin area lies offshore, with acreage in both the Pacific and the Atlantic oceans. The shallow waters of the Caribbean coast

in the north have seen some exploration success, with the 1977 discovery of the Chevron operated Chuchupa gas field in the Guajira Offshore Basin. With reserves of 3.7 Tcf (666 MMboe) it is the country's only offshore producer. This field, together with coastal Ballena and Riohacha gas fields in the onshore Guarija Basin, provides on average 500 MMcfd (90 Mboepd), approximately 80% of Colombia's total gas output.

Exploration in deeper waters has so far been less profitable, but ANH believes that

there is considerable potential in both the shallow and deep waters of their Pacific and Caribbean territory, estimating that gas reserves in excess of 50 Tcf (9 Bboe) remain to be found offshore. Wavefield Inseis recently acquired over 8,000 line kilometres of long offset 2D multi-client data from both the Caribbean and Pacific, in water depths of up to 2,000m. This should be of great interest to companies interested in a Colombian Pacific deepwater round, planned for the first quarter of 2009.

## Magdalena River Valley

Magdalena, the principal river of Colombia, rises at the bifurcation of the Central and Eastern Cordillera, and flows northward for about 1,500km to the Caribbean Sea. It flows through the Magdalena River Valley. The valley is filled up with continental sediments of Tertiary age.

The prolific Middle Magdalena Valley Basin has produced 2.2 Bbo with both light and heavy oil sourced principally from the La Luna Formation. Gas production is established from the Paoya and Serafin fields. Heavy oil production with potential reserves of more than 500 MMbo is established in the southern part of the basin.



Photo: Black Rock Oil

Photo: DITUP



## Anybody interested?

In addition to the 78,810 km<sup>2</sup> of acreage available through the 2008 Colombia Round, the country is promoting a 'mini round' offering blocks in well-established provinces like the Magdalena Valley and the northern Llanos basin.

With a thriving democracy, an economic growth rate of 7.5% last year, and a modern and transparent hydrocarbon sector, the industry is changing in Colombia. As Mr. Zamorro points out "we had no major discoveries for many years, but we had no major foreign investment either. With licensing and drilling activity increasing, and a wildcat success rate of 45%, we are hoping to attract foreign investors with capital, technologies, expertise and enterprise."

It will be interesting to see whether Colombia can rise to its ambitions and become a major player in the world hydrocarbon industry.

Cartagena is situated on the north-west Caribbean coast of Colombia. Founded in 1533, it was one of the first cities to be built by the Spaniards in South America. The fortress walls surround the old town, where churches, homes, business and plazas share their colonial heritage. It is the principal oil port of Colombia, with a large refinery which processes the oil brought by pipeline from the Magdalena Valley oil fields. Over 20,000 km<sup>2</sup> of acreage has been offered by the Colombian government to the south-east of Cartagena, and the city is conveniently placed for the exploitation of any commercial discoveries in this area.

## A Great Place to do Business

John Cubitt, Managing Director of Black Rock Oil and Gas, had more than 25 years experience in the oil industry when he joined the company in 2005 - but none in Colombia. "Like so many people, I had many preconceived ideas about the economic, political and security situation in Colombia, all of which were wrong," he explains. "I have been very impressed with the way the strong government of President Uribe has dealt with the problems of insurgency, terrorism and drug cartels with a mixed 'carrot and stick' approach. They have maintained a hard line, driving terrorists to the more remote areas, but at the same time offered arms amnesties which have successfully brought the insurgent groups into the political and democratic process. As a result, an environment of stability and prosperity has been developed in the

cities and main agricultural regions, with a less disaffected and disenfranchised poor."

"This upsurge of economic and political security has also been instrumental in the sudden growth in hydrocarbon discoveries in the country, as levels of foreign investment have leapt up," John continues. "We find it a very interesting area to work in. Our biggest assets are heavy oil fields in the Middle Magdalena Valley, although there is a possibility of lighter crude at depth. We are not operators, as heavy oil is a specialist area, requiring stimulation like steam injection to make it flow."

"When I first went to Colombia I was stunned by how different it was from my perceptions. The people are very welcoming and encouraging and it is a great place to do business," John concludes.



Photo: Jane Whaley

John Cubitt is Managing Director of Black Rock Oil and Gas, a small independent Australian company with a number of assets in Colombia.

# Shallow Oil – By Serendipity

“Increasingly favourable economic and political conditions, in combination with recent oil policy reforms, make Colombia one of the world’s most sought after markets in the petroleum sector,” says Tom Wolden, Chief Operating Officer of InterOil.

InterOil, established in 2005, and headquartered in Oslo, is a small Norwegian company spending their entire budget outside Norway, meaning that they are not taking part in the exploration bonanza on the Norwegian continental shelf. Instead, the small but efficient company has secured production and promising exploration acreage in South America (Colombia and Peru) and Africa (Angola and Ghana). InterOil’s proven reserves in Colombia now total 3.37 MMbo and 2.98 Bcf of natural gas (P2 reserves). In 2007, production in Colombia averaged 585,000 bopd following the successful drilling of several production wells.

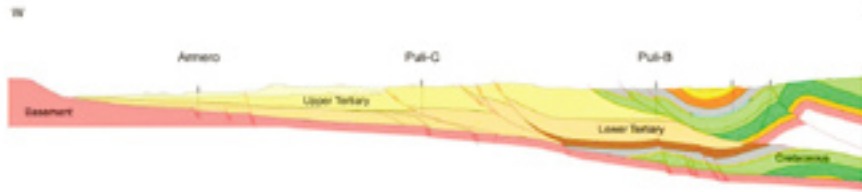
InterOil’s acreage in Colombia is located in the Middle Magdalena Valley Basin and the Llanos Basin.

“Our interpretation of a 3D seismic acquired in 2006 resulted in drilling of 11 production wells and 1 exploration well. 10 out of the 11 production wells drilled during 2007 were oil producers and led to a production increase of 64% compared to 2006,” says Wolden.

The company’s first exploration well in the Paraiso block in the Middle Magdalena Valley Basin penetrated several intervals of oil-bearing sands, but the logging results indicated that the wells were not commercial. During the drilling campaign, however, oil was discovered in a shallow formation at approximately 6-800m. The potential for oil production from this interval has now been tested with a flow rate of 80 bopd per day. InterOil will therefore drill 8 shallow wells during Q2 2008. The wells can be put on production immediately.

“This year we were also awarded the Altair block in the highly prolific Llanos Basin,” says Wolden. InterOil will be the operator of the block (160 km<sup>2</sup>) with 100% working interest.

“This is our first license award in Colombia, and it is surrounded by established oil production and infrastructure. Estimated resources are in the range of 27 – 33 MMbo. InterOil is committed to shoot 150 km of seismic and drill 1 exploration well within 18 months.”



X-section through the Middle Magdalena Valley Basin with location of InterOil acreage.

Courtesy of InterOil



COO Tom Wolden checking output at the Mana license in the Upper Magdalena Valley.



InterOil workers, production well on the Mana license.