

Saba Bank, Dutch Antilles Petroleum Potential

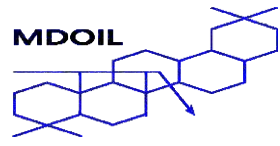
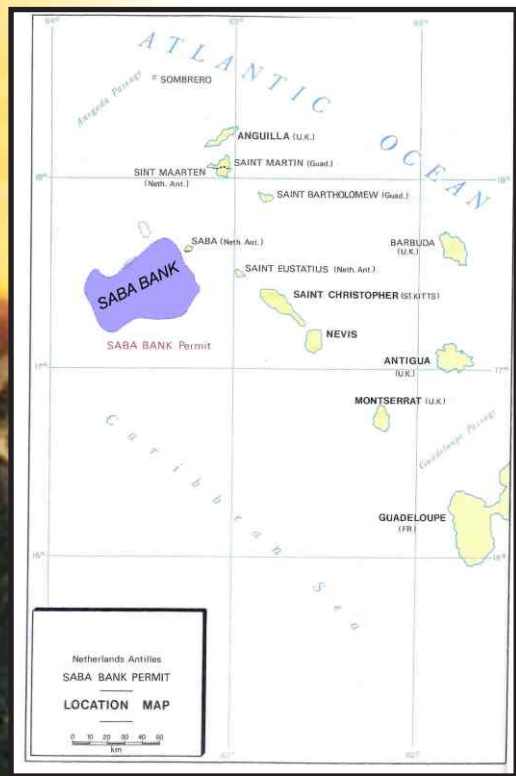
New opportunities, New Petroleum Geochemical Data *Updated January 26 2007*

The Saba Bank area constitutes a frontier hydrocarbon exploration opportunity with considerable potential. The Saba Bank is a shallow water submerged carbonate bank in the northeast Caribbean Sea 5 km southwest of the northern Netherlands Antilles island of Saba. The bank covers approximately 2,200 km² and has a water depth ranging from 10-100 metres and generally less than 50 metres. It is the second largest carbonate bank in the world. Two wells, SB #1 and SB #2 were drilled on the south-east of the bank in the southern Tertiary province in 1977 and 1982.

The presence of numerous shows typed to an upper Cretaceous/ Lower Tertiary Marine Marl source (Jan 2007) in both wells indicates significant source potential, which is thought to lie at depth under and extending out beyond the flanks of the Bank.

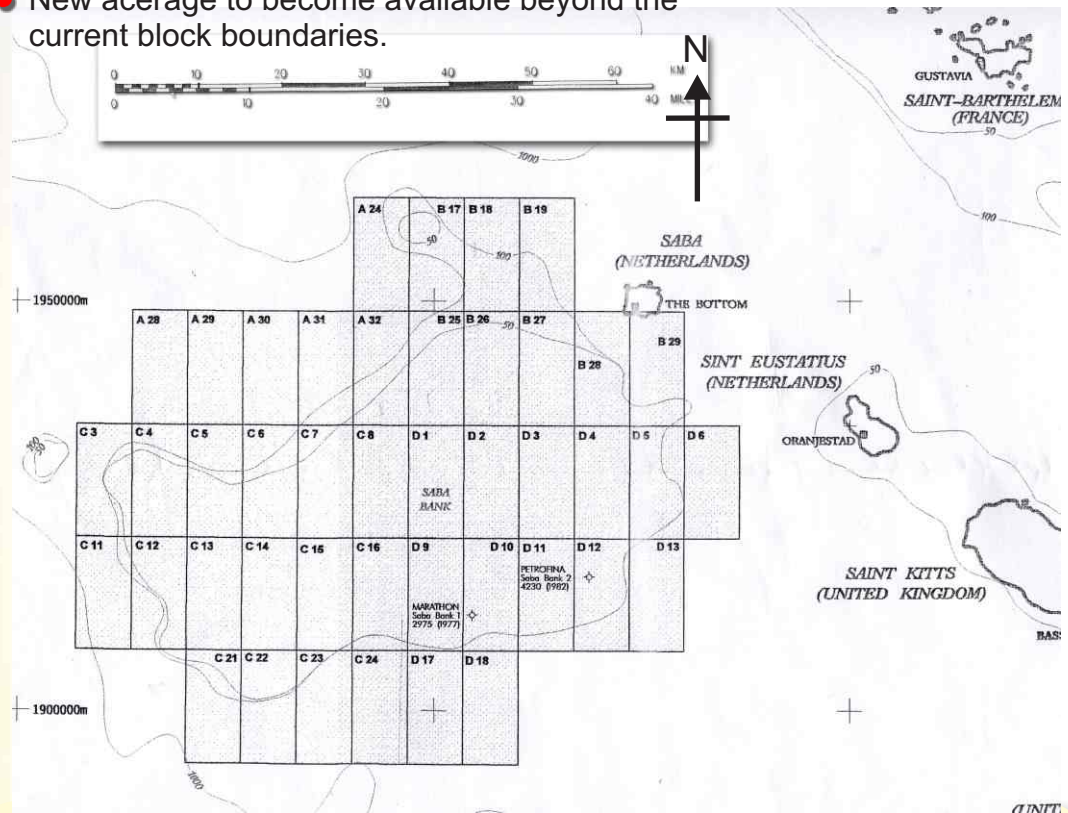
The Saba Bank presents very favourable stratigraphic and structural conditions for the commercial accumulation of oil and gas.

Recent work has confirmed the potential for at least 7Tcf recoverable in two leads alone.



Available Acreage

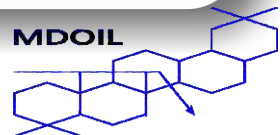
- The available acreage consists of 43 contiguous blocks (each block = 91.86 km²).
- New acreage to become available beyond the current block boundaries.



Exploration History

- 1969 Deep Sea Drilling Program Well 0030 as part of Leg 4 was drilled on Aves Ridge.
- 1970 First 2D seismic shot over the Saba Bank by United Geophysical Company .
- 1971 Fox et al published results of dredging survey over Aves Ridge (Fox et al. 1971). Shell acquire 2 regional seismic lines over the Aves Ridge Deep Sea Drilling Program Well 0148 as part of Leg 15 was drilled on Aves Ridge.
- 1972 USGS carry out a regional 2D seismic survey that crosses the Saba Bank.
- 1973 Weeks Natural Resources commenced exploration over Saba Bank with a 2D seismic survey over the Saba Bank carried out by GSI.
- 1974 Kearey published results of geophysical surveys over the Aves Ridge (Kearey, 1974).
- 1974 Weeks Natural Resources continued exploration on Saba Bank with second 2D seismic survey carried out by CGG.
- 1976 Petroleum Law passed for Saba Bank area Netherlands Antilles. Saba Bank Resources created. PSC with Marathon signed.
- 1977 Marathon spudded SB1, abandoned as dry hole with minor gas shows after penetrating Paleocene andesites at a depth of 2975m.
- 1979 Fina signed PSC with Saba Bank Resources.
- 1980 Fina commissioned 1700km of 2D seismic over the Saba Bank, acquired by Western Geophysical.
- 1982 Fina spudded SB2, abandoned as dry hole with minor gas shows after penetrating Paleocene andesite at 4231m.
- 1984 Robertson Research produced a report on the geology and hydrocarbon potential of the Caribbean with particular reference to the Saba Bank, (Robertson Research, 1984).
- 1988 Aladdin signed PSC with Saba Bank Resources. Aladdin acquired 343km of 2d seismic
- 1989 AJW Consultants report on the potential of the Saba Bank, (Warner & Kubena, 1989).
- 1999 SBR acquired 205km of 2d seismic from Western Geophysical. Aladdin survey was also reprocessed and 3 Fina lines were reprocessed and digitised.
- 2004 Church and Allison publish a report on the petroleum potential of the Saba Bank, having reviewed the seismic data acquired to date, (Church and Allison, 2004).
- 2007 New Petroleum geochemical data (Matchette-Downes 2007) confirms marine marl source presence of probable Upper Cretaceous / Tertiary age.

Saba Bank Petroleum Resources



Geological setting

Geological setting

The Saba Bank is located at the leading edge of the complex Caribbean Sea Plate at the northern tip of the Aves Ridge. It is thought that the Bank might belong to the Cretaceous province that includes the Aves Ridge, located on the northern end of the Grenada Trough. The Trough itself accommodates a potentially vast source kitchen. The low geothermal gradient $26^{\circ}\text{C Km}^{-1}$ (20mWm^{-2}) would allow deeper sources, such as the Upper Cretaceous to work as indeed it does as evidenced through the Saba Bank #1 and #2 well shows.

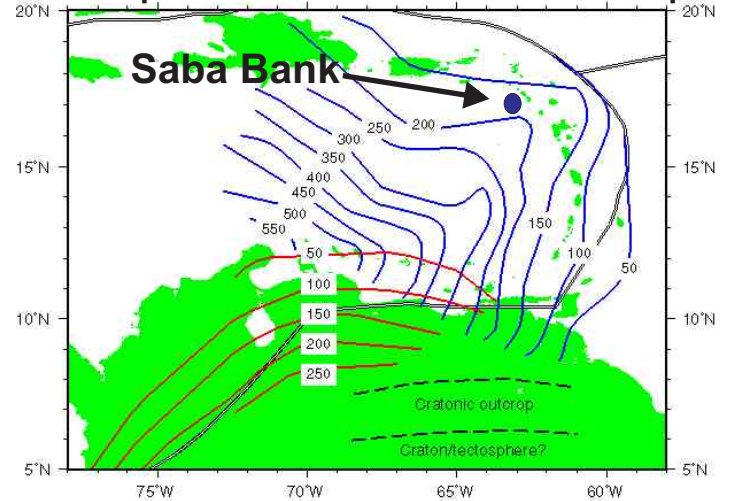
The Saba Bank comprises of a carbonate sequence overlying a Tertiary basin to the South-East and an untested Cretaceous basin to the West.

The diagram below shows the measured in km, and marked with blue contours. The Caribbean crust thickness is marked with red contours. (Based on Ysacois 1998 using tomographic data from Van der Hilst and plate boundaries from the NUVEL-1 plate motion model {DeMets etc al., 1990}).

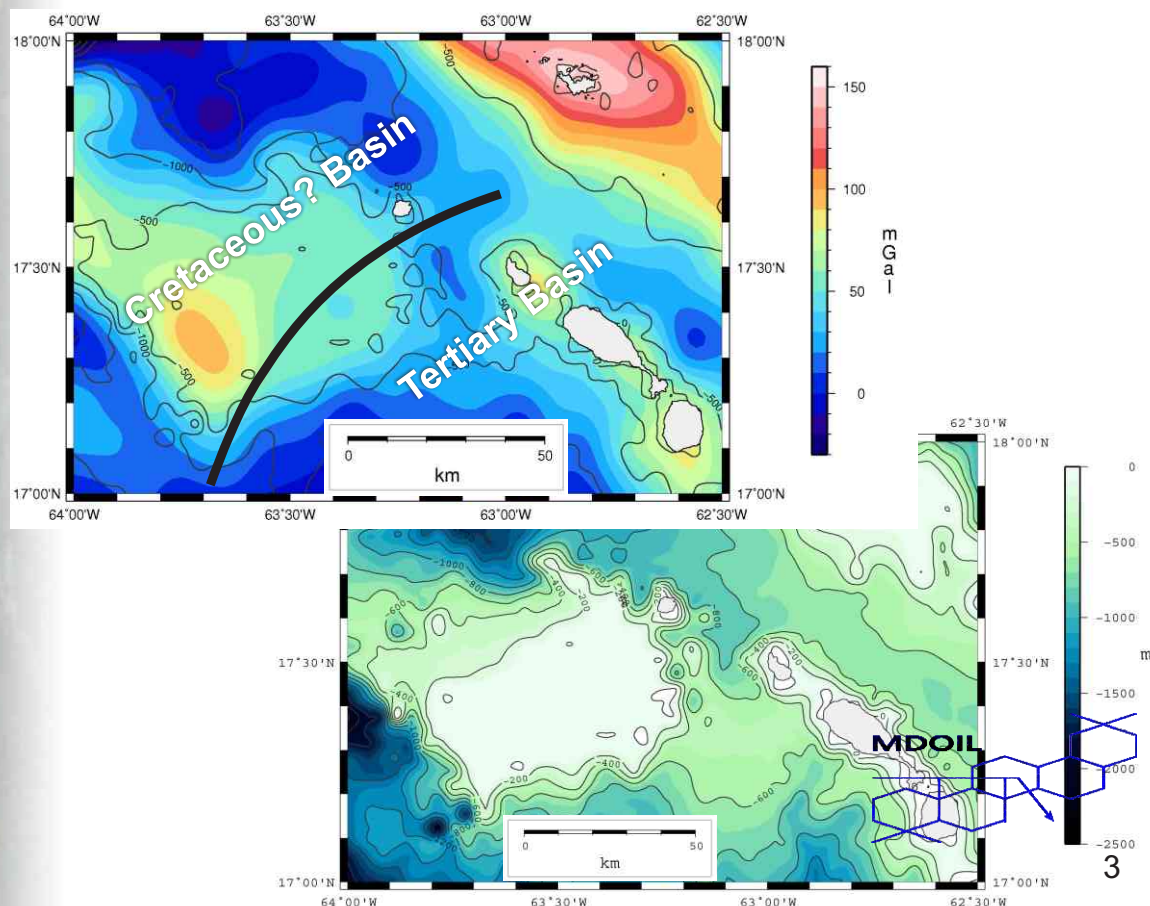
Similar tectonics are known to exist in the oil prone and prolific island arc petroleum basin settings of Indonesia.

depth of the subducted Atlantic crust,

Atlantic plate subduction under Caribbean plate



Saba Bank - Free-Air Gravity (1:1,000,000)

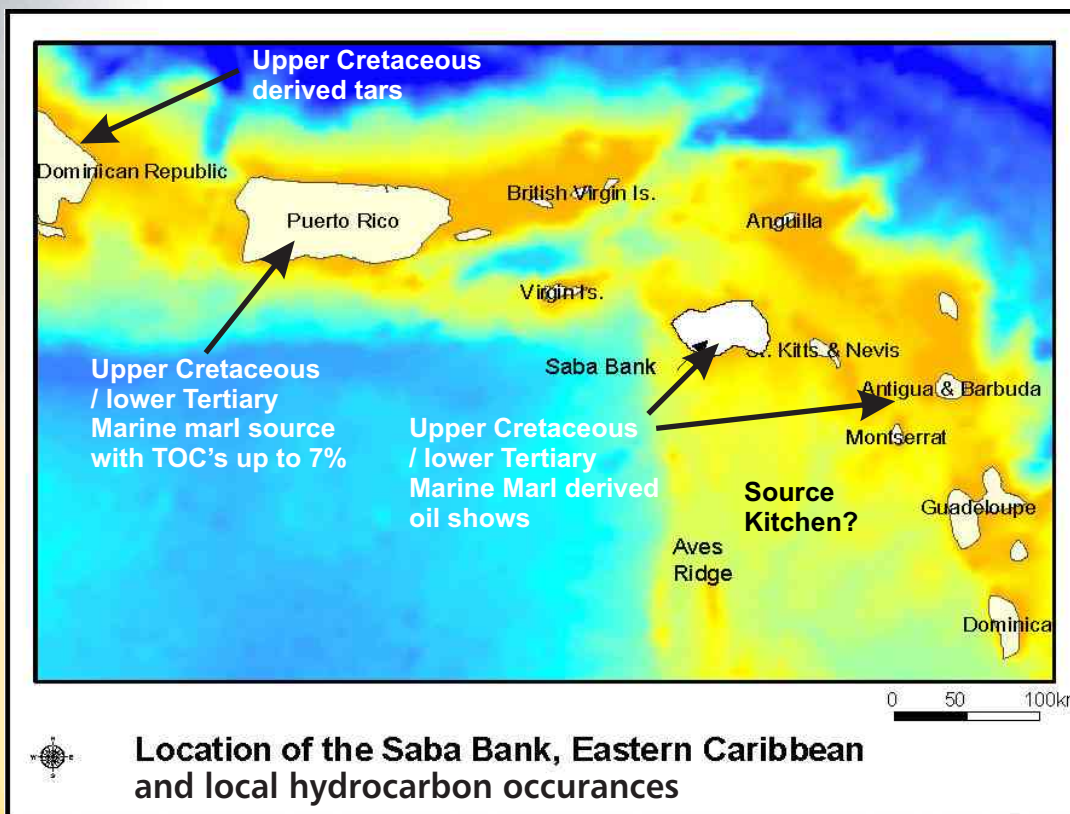


Saba Bank Petroleum Resources

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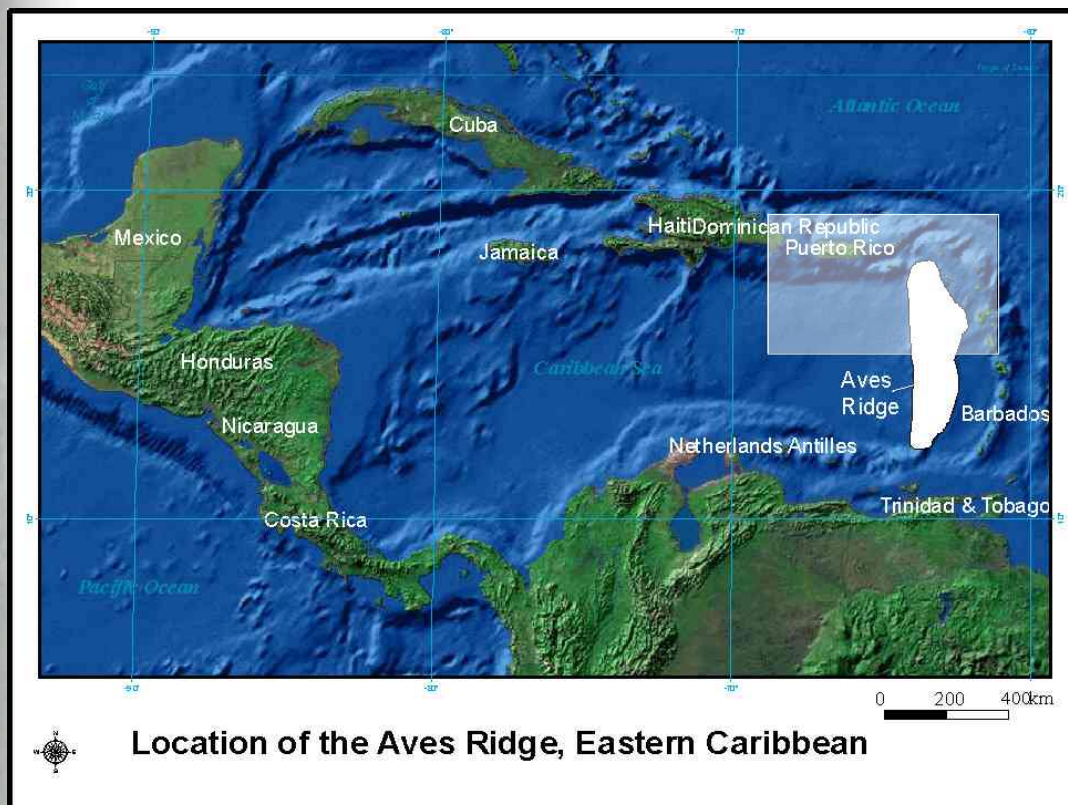
Geological Setting

Saba Bank Petroleum Resources



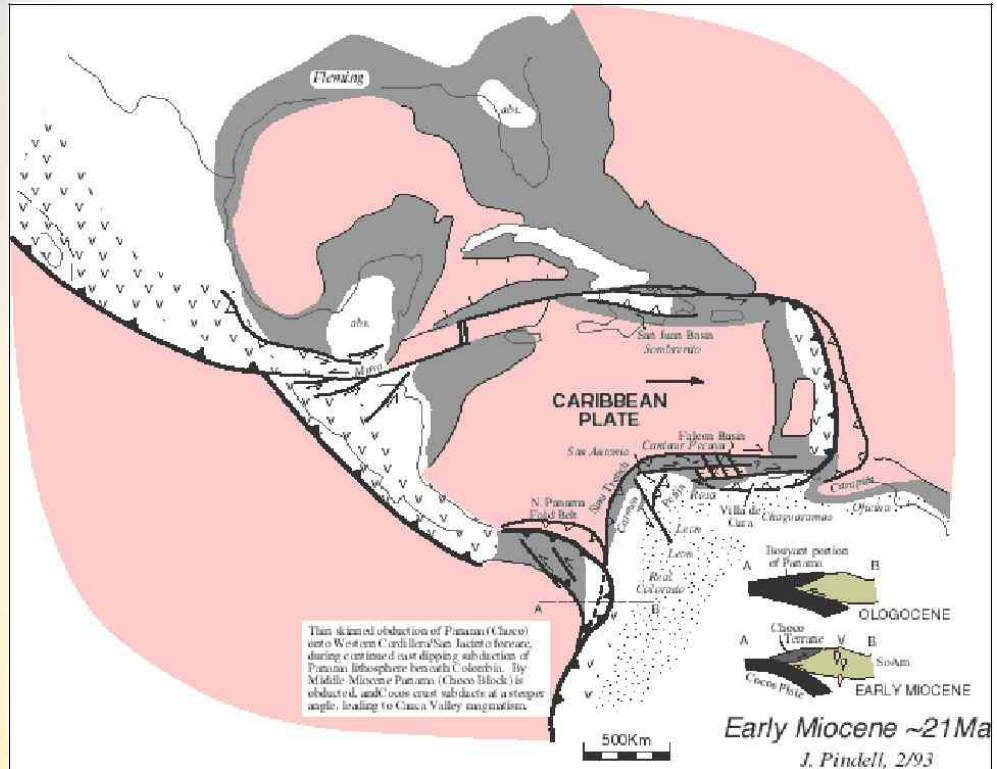
The map above shows the location of the Saba Bank, with rough bathymetry. Saba bank is a bathymetric high of average 50m waterdepth. Colour scheme in hot colours indicate shallow water depth, cold colours indicate deep water (Ref IHS Energy, Ref P. Goddard 2005).

The map below of the Aves Ridge, shows rough bathymetry and topography. Area of Aves Ridge shown in lighter rectangle. The area of the map above is shown by white rectangle (Ref IHS Energy Ref P. Goddard 2005)



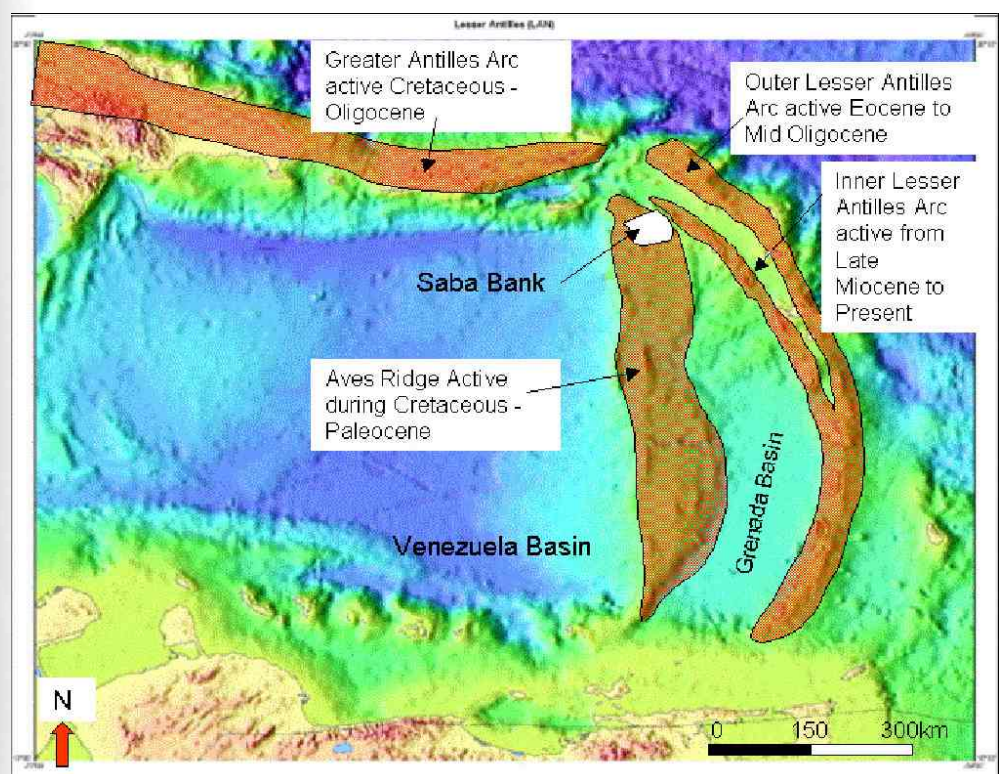
Geological Setting

Saba Bank Petroleum Resources



The diagram shows Tectonic Evolution of the Caribbean Plate according to Pindell 1994. This represents the Pacific Model for the origin of the Caribbean Plate representing early subduction polarity reversal (Aptian). Cenozoic history is not exclusive to this Pacific model (Ref Pindell 2003).

Below we see the positions of present and past active arcs of the eastern Caribbean. The base map is a bathymetric map from www.USGS.gov with cold colours representing deep water, warmer colours representing shallow areas.



SBPR

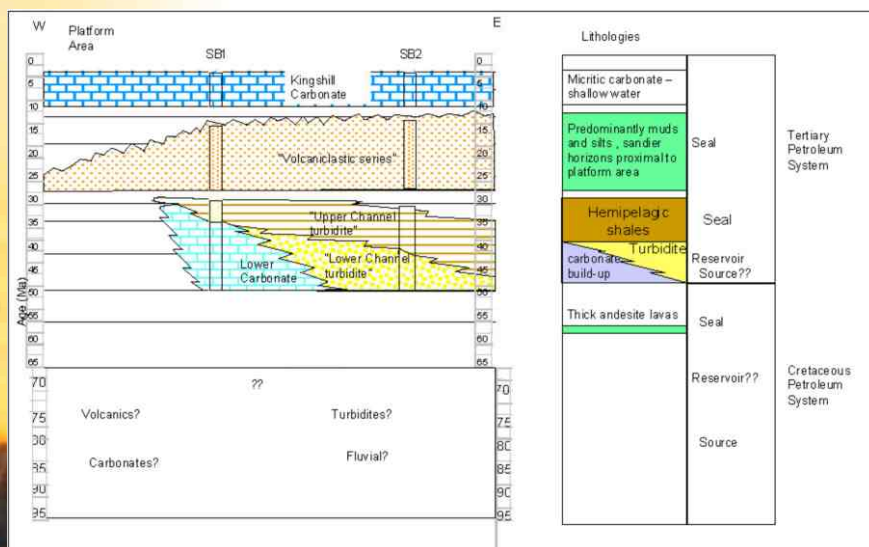
Stratigraphy

SB #1 & 2 wells confirm the presence of a thick but varied Tertiary section, with excellent reservoir properties at a number of levels (carbonates and sandstones).

Both wells encountered the Upper Carbonate Unit (The Kingshill Carbonate) overlying siltstones and claystones of the Fluvio-Deltaic Sequence.

SB #1, some 15km to the West of SB #2, encountered a carbonate sequence in the basinal section. This Lower Carbonate unit is not present in SB #1. Here the unit is represented by a thick turbidite sequence. Both wells TD'd in Andesite and the pre Tertiary geology can only be postulated based on the presence of Cretaceous reworked sediments seen in both wells.

No Palaeozoic or Mesozoic rocks are known to outcrop in the Lesser Antilles, however, seismic data strongly suggests the presence of a deeper and thick pre Tertiary sedimentary sequence.



Biomarker analysis of the shows also provides clues as to the nature of the deeper geology.

Both wells were drilled in the Tertiary basin to the South-East, ***the Cretaceous basin to the West has not been tested, nor was the Palocene source potential.***

A large basin underlies the southwestern 40% of the Saba Bank, (Ref Meyerhoff 1984).

Reservoir rocks

Good to excellent reservoir properties are recorded throughout the post Andesite Tertiary. Visual porosity indications for the Upper Limestone unit range from 10 to 25%.

Marathon recorded fair to excellent porosities in the Fluvio Deltaic Unit in SB #1.

10 to 25% porosity was observed in the Lower Carbonate Unit, with moldic porosity values as high as 40% in places in SB #1. Porosities in the equivalent Channel Turbidites in SB #2 were much lower and generally around 10%, however the well penetrated the most distal of part of the turbidite sequence and the more proximal settings are likely to have significantly higher porosities.

Extensive lost circulation occurred in SB #1 and to a lesser extent in SB #2.

It is anticipated that the pre-Andesite section will contain quality sands based on the presence of the reworked material within the Tertiary section.

Evidence of Hydrocarbons

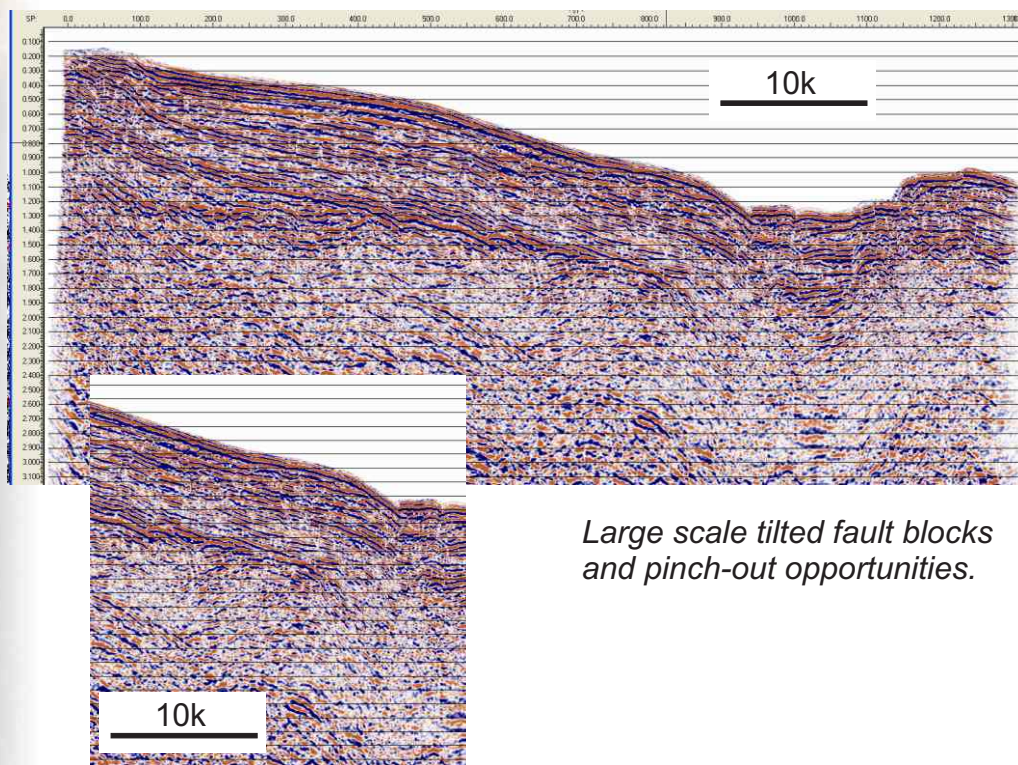
Significant shows have been recorded. Saba Bank #2 was tested and C1 to C5+ hydrocarbons were recovered, however it was thought that the formation was badly damaged as severe mud losses occurred whilst drilling the bottom section. Solvent extraction of the selected intervals resulted in the identification of small quantities of liquid hydrocarbons; there is the possibility that these hydrocarbons are migrant hydrocarbons and not in situ source rock extracts.

A review of the two previously drilled exploratory wells has generated new and revised play concepts which strongly indicate that the Saba Bank definitely warrants further evaluation of its petroleum potential.

Seismic Interpretation

Interpretation of the seismic has revealed several drillable prospects; carbonate reefs of Eocene age; a number of prospects and leads associated with the stratigraphic plays e.g. channel/turbidites/deep sea fans of Oligocene to Eocene age (and older) and underlying tilted fault blocks (e.g. The Cende prospect in the Cretaceous basin to the West).

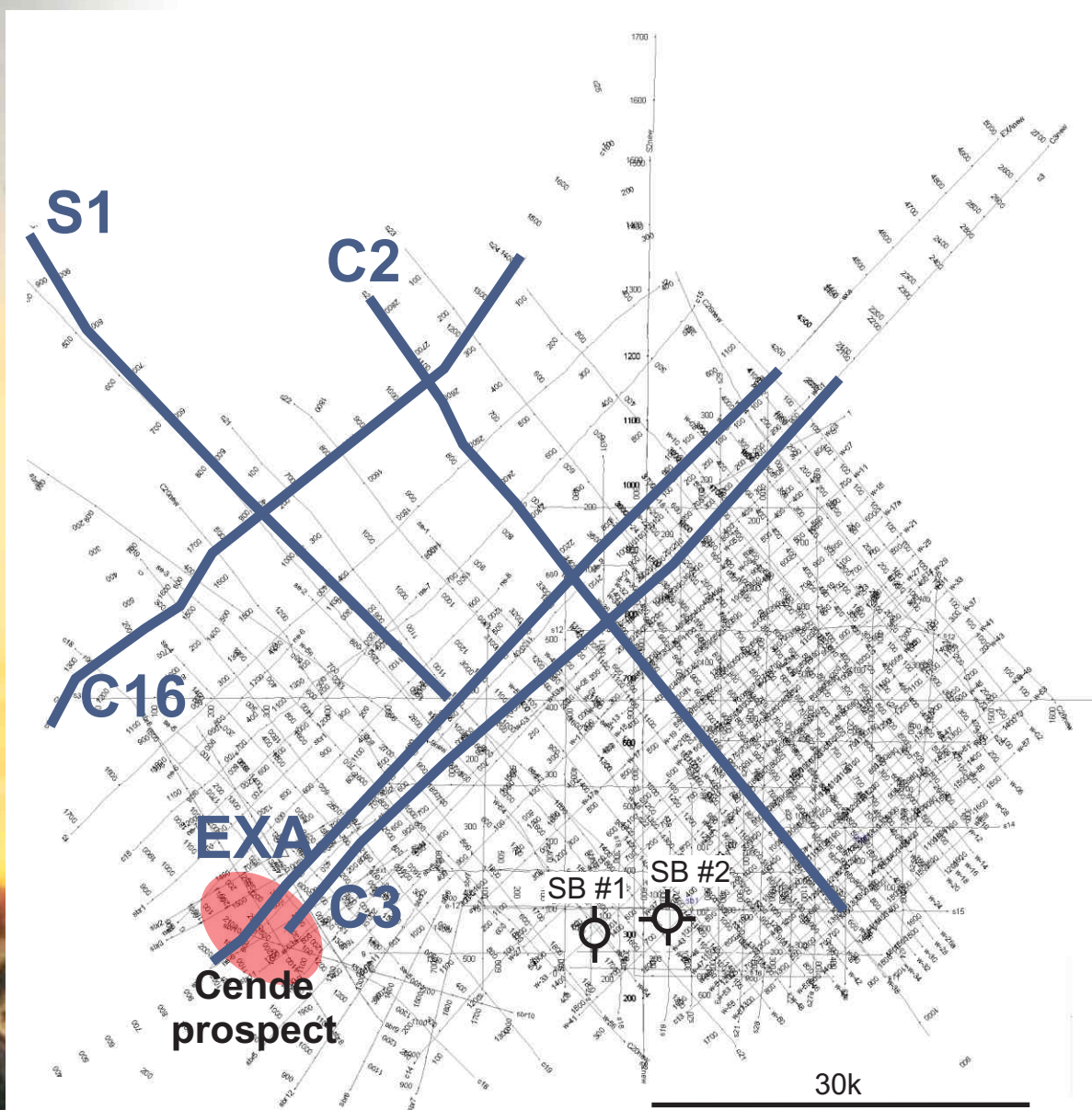
Line S1



Large scale tilted fault blocks and pinch-out opportunities.

The Seismic Database

Saba Bank Petroleum Resources



The data is available as a Kingdom Suite project.

The regional lines away from the Bank are also available.

Approximate locations of SB #1 and #2 and Cende prospect are shown.

Saba Bank #1

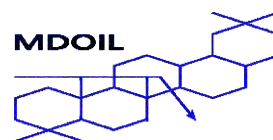
Lat 17 deg 17' 22.098" North Long 63 deg 25' 38.043 West

Saba Bank #2

Lat 17deg 19' 56.258" North Long 63 deg 17' 43.041 West

Ref Fina

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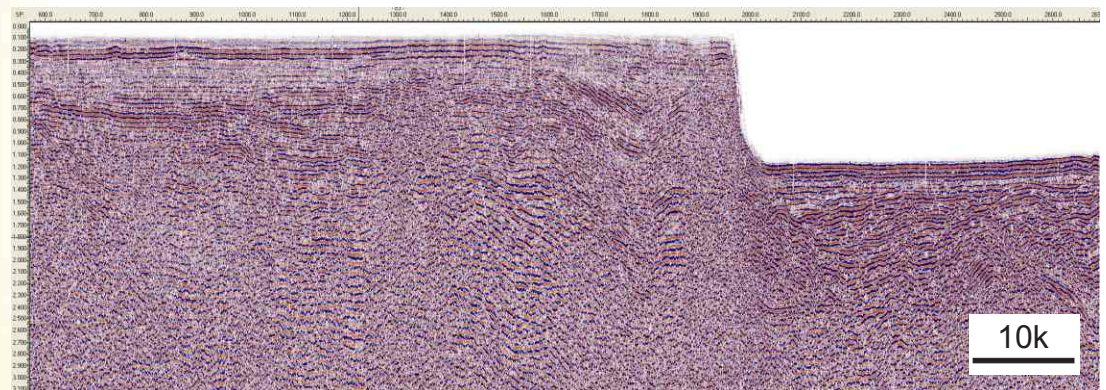


The Seismic

Line C3 Large tilted fault blocks are present both within the Saba Bank platform and on the flanks of the platform. Slumping on a vast scale can also be seen.

The shelf edge faults would allow hydrocarbon migration into the platform areas.

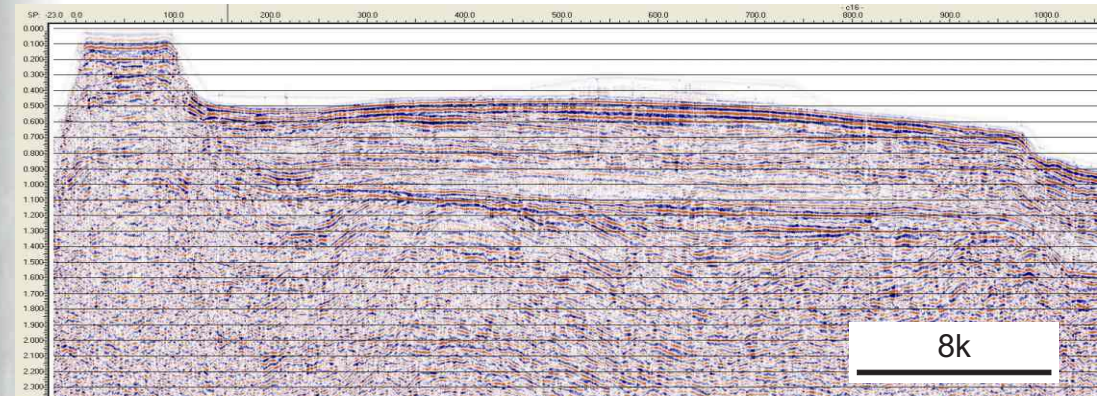
Line C3



Line C3



Line C16



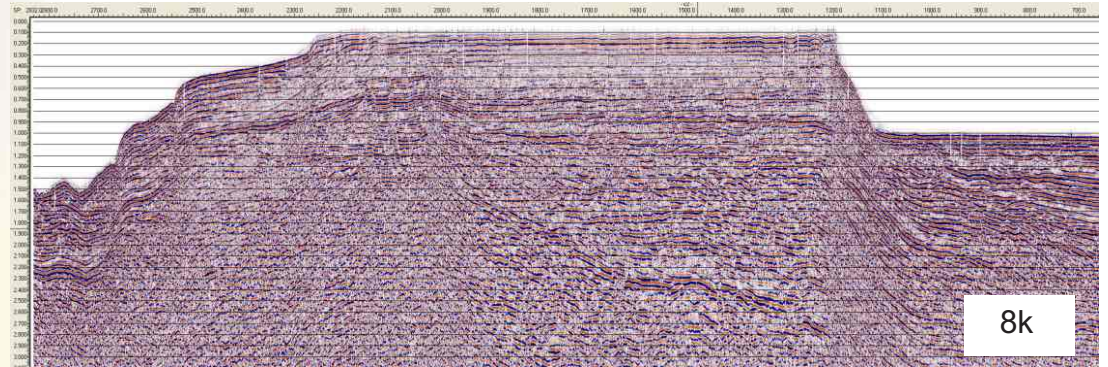
Two large truncated tilted fault blocks can be seen, the erosional surface at approximately 1.2 seconds TWT.

Saba Bank Petroleum Resources

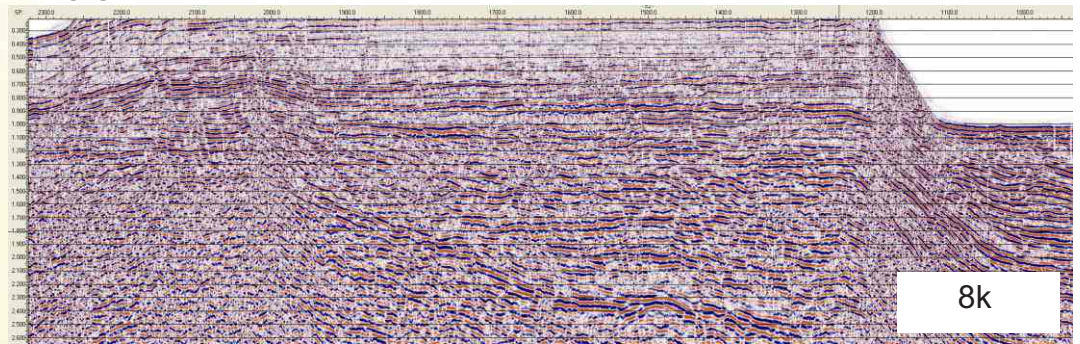
Line C2

A very large tilted fault block with possible gas escape features can be seen at the crest of the tilted block.

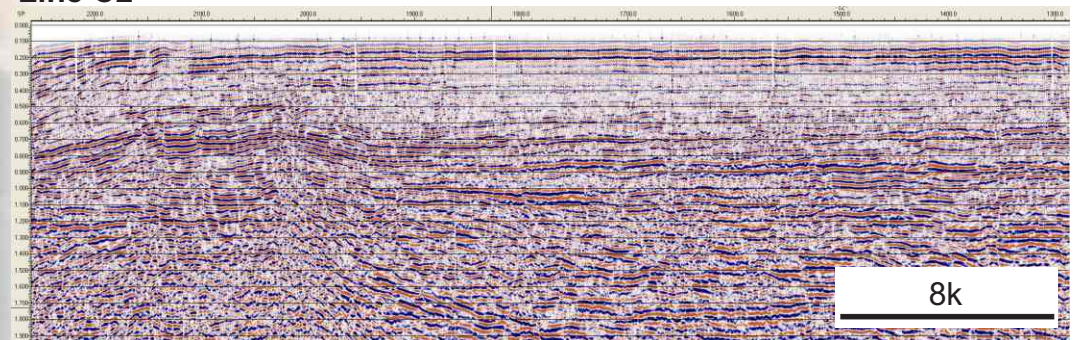
Line C2



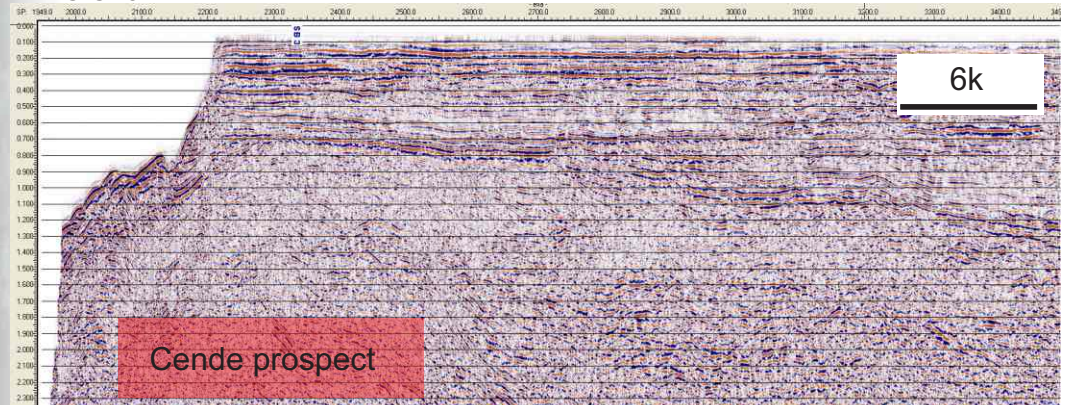
Line C2



Line C2

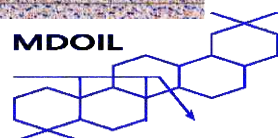


Line exa



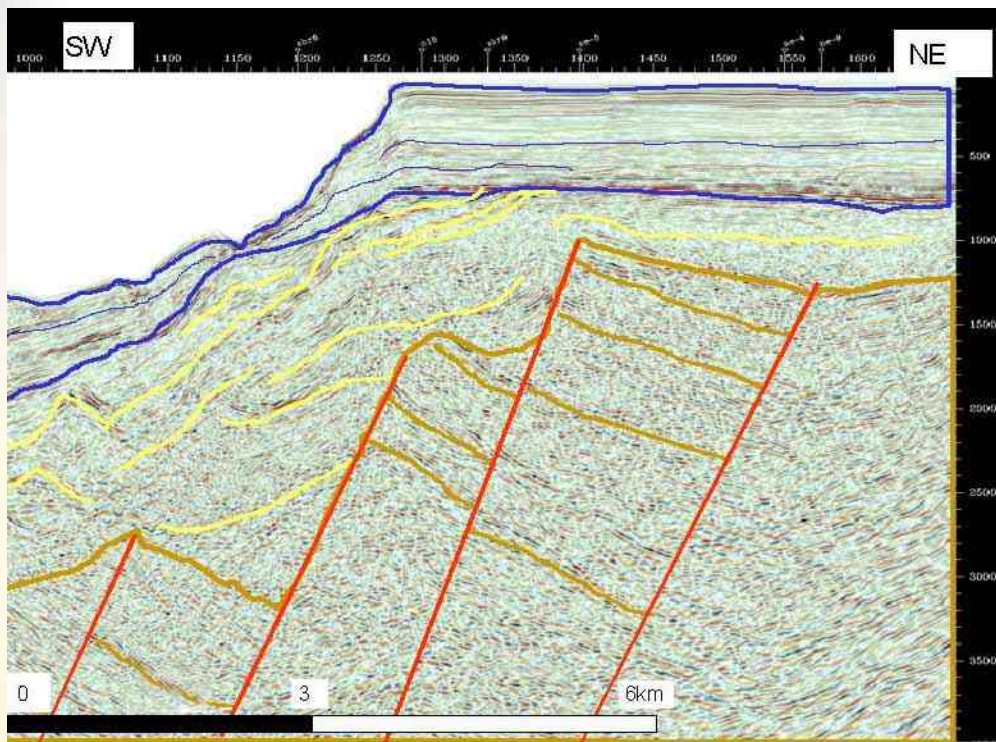
The western end of the line images part of the Cende prospect.

SBPR



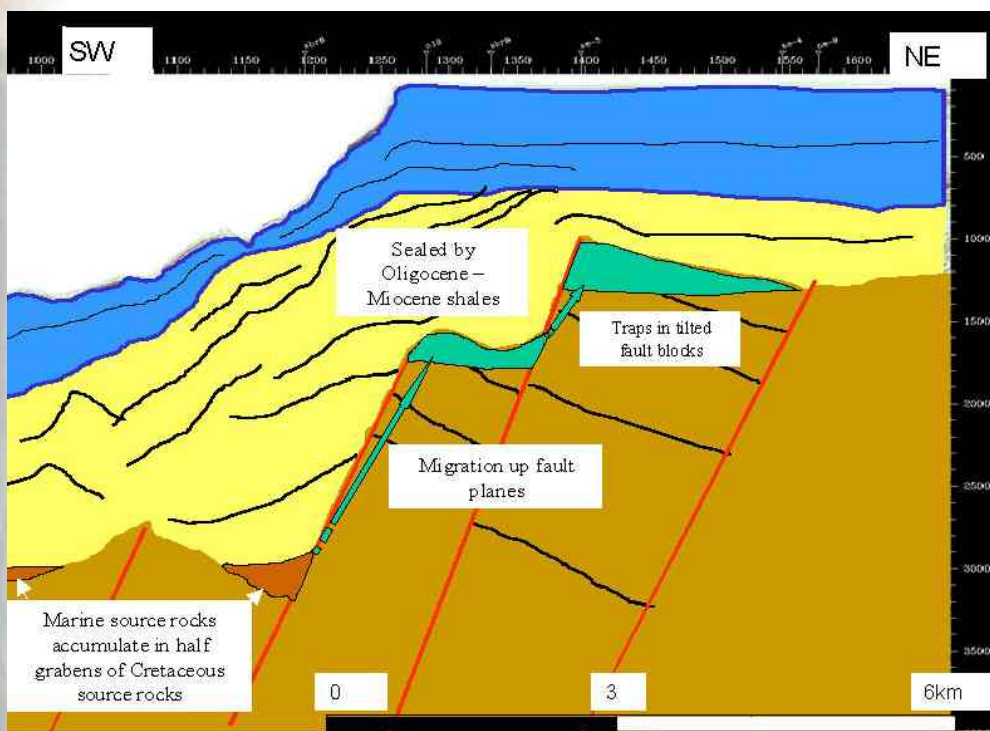
The Interpretation

Saba Bank Petroleum Resources

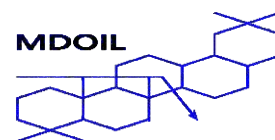


The seismic section above shows plateaux margin tilted fault blocks (ref P. Goddard, 2005).

Cretaceous tilted fault block below exhibits a shelf edge play showing the migration of hydrocarbons from source rocks accumulated in half grabens into footwall traps, (ref P. Goddard, 2005).

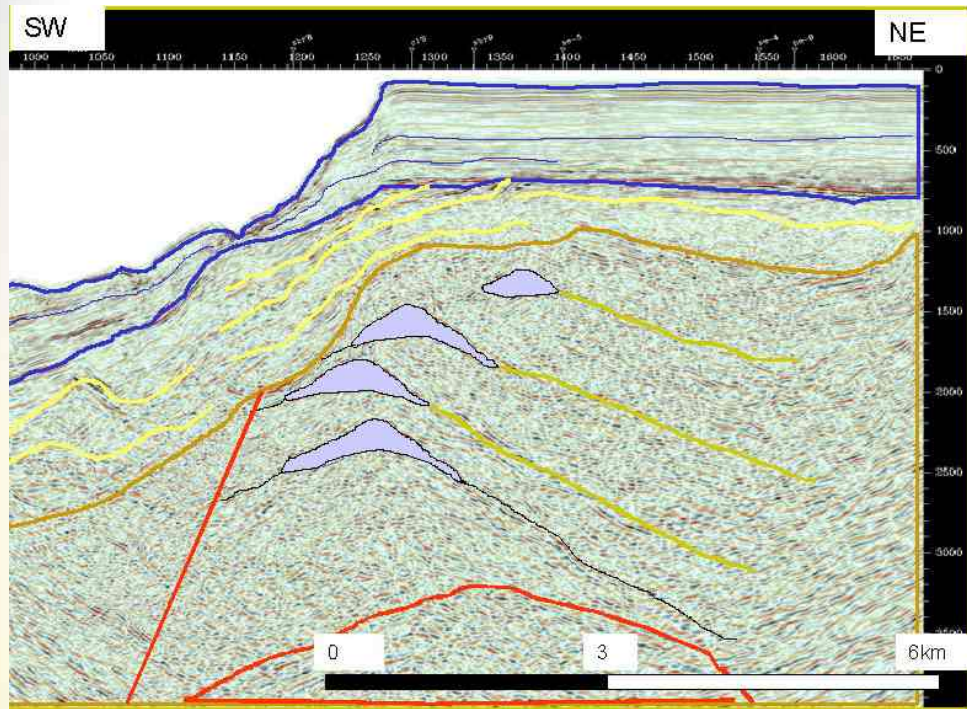


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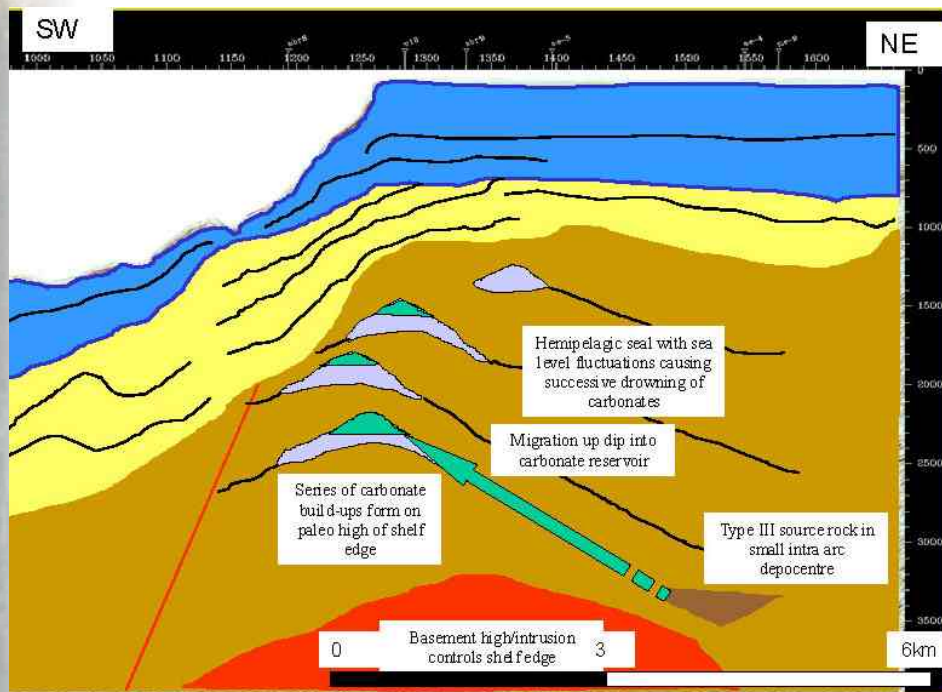
The Interpretation

Sabah Bank Petroleum Resources

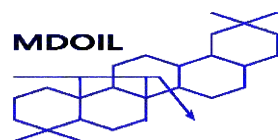


Shelf Edge carbonate interpretation showing less faulting and possible basement high (in red), underlying paleo and present shelf edge (ref P. Goddard, 2005).

Shelf Edge carbonate cartoon of play concept (ref P. Goddard, 2005).



SBPR



The Prospects

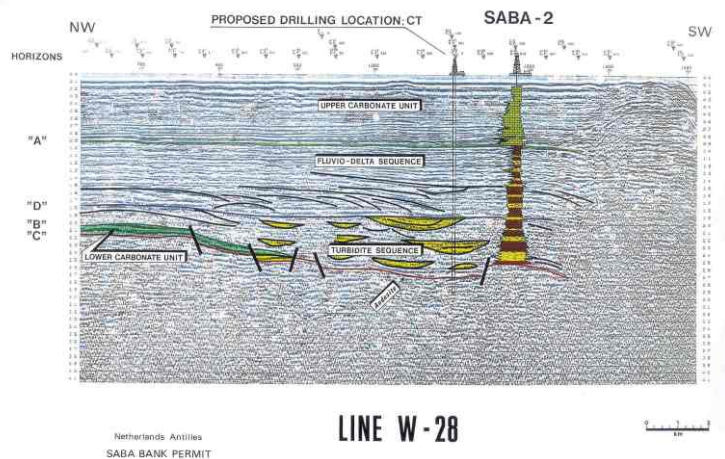
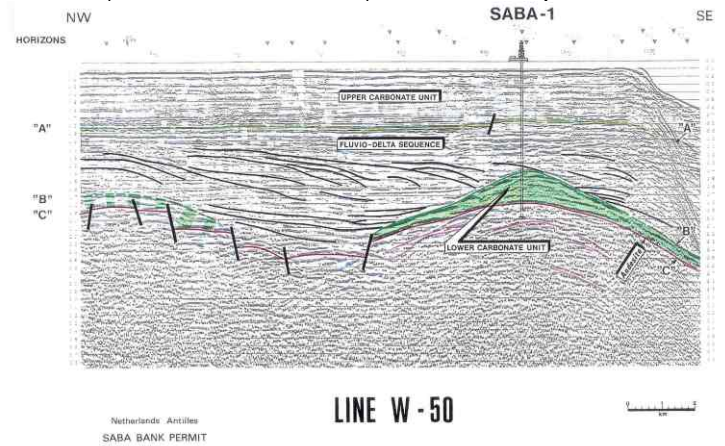
Saba Bank Petroleum Resources

The Prospects

Saba Bank #1 encountered 936m of carbonate, 919m of fluviodeltaic volcanoclastics and a further 921m of carbonates and TD'd in Andesite above the oil window. Gas shows were recorded at 2,140 meters and 2,380 meters (Ref line W-50). Reworked mature pre-tertiary source rock material was found.

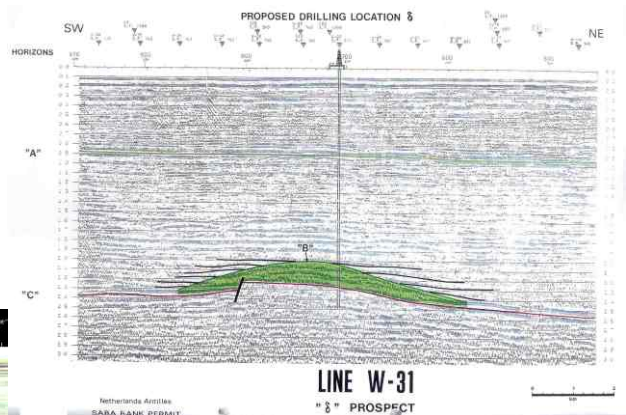
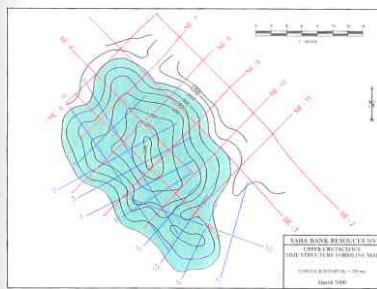
Saba Bank #2 was drilled on a seismic anomaly which was interpreted as a carbonate build-up on a basement high. In fact distal turbiditic deep sea fan facies with low to moderate porosity and permeability characteristics were found.

These turbiditic sands however contained C1 to C5 gases. One interval was tested, but due to severe mud losses the interval was likely to have been damaged and no further hydrocarbon data was recorded. Recent work by P. Goddard indicates the potential for several Tcf of gas within the Saba Bank blocks.

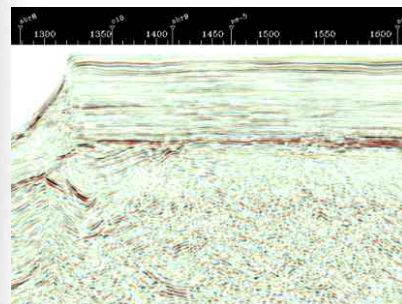


The "δ" lead

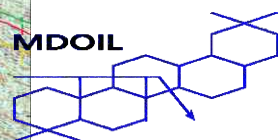
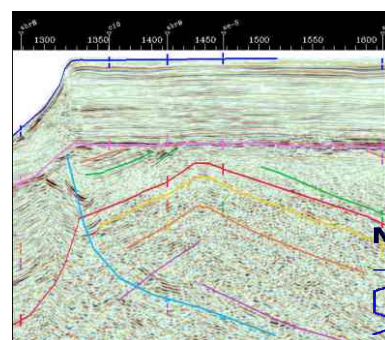
The "δ" lead worked up by FINA is prognosed to be a carbonate build up with some ~700 million bbl potential. Other leads have been worked up by FINA.



The Cende prospect



Potential reserves for the Cende prospect are very high (~ 500 Million bbls)



Source rocks and the oils

Whilst no source facies of any particular note were encountered by the drill bit, their presence is indicated at depth.

The top of the oil window is reached at a depth near to the TD of the wells so it is envisaged that the source rocks will be optimally mature in the upper Cretaceous section and in the lows away or under the Bank.

Upper Cretaceous source rocks are present in the region as reworked mature Cretaceous source material can be found within the sediments of both well bores.

P. Goddard noted the likelihood of "Cretaceous nearshore shallow water clastics with a significant input of terrestrial organic matter".

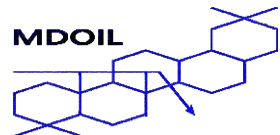
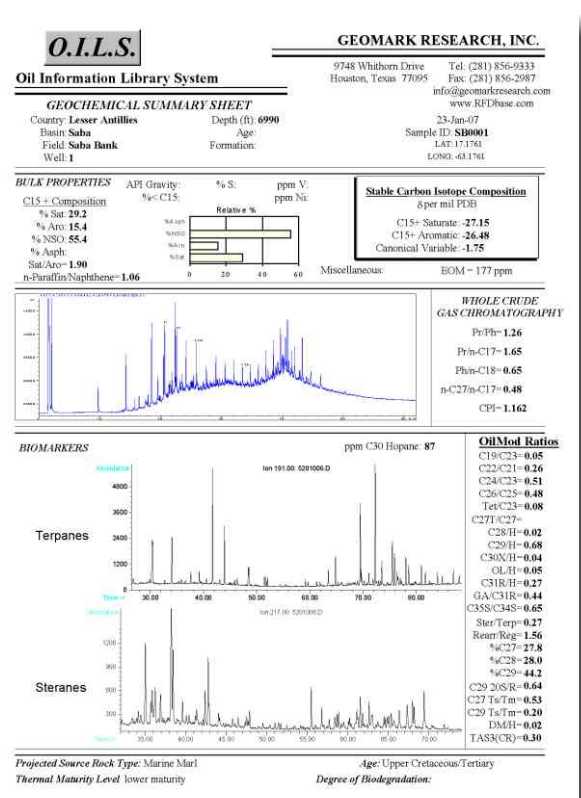
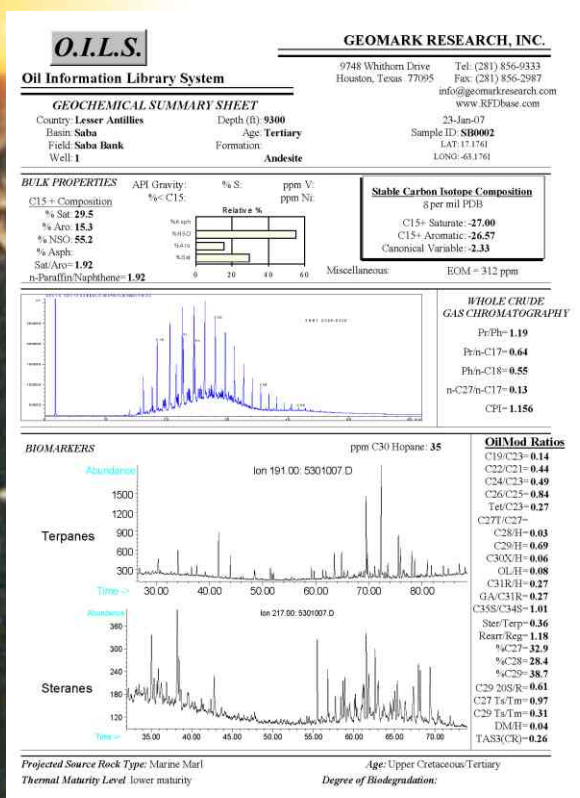
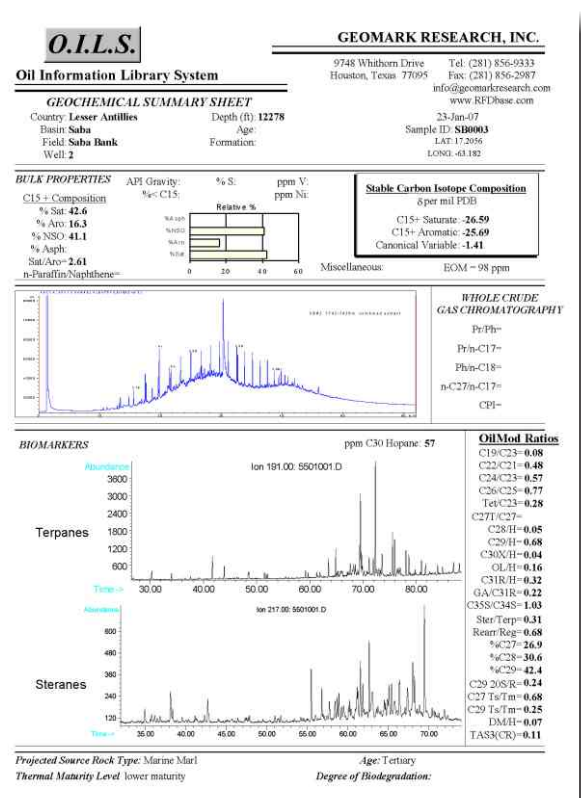
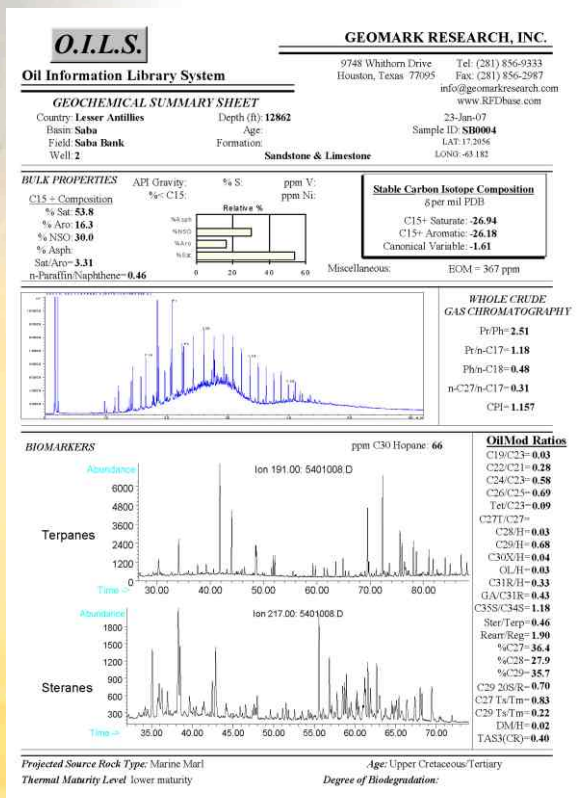
The presence of source rocks is also confirmed by the presence of significant quantities of both liquid and gaseous (wet gas) shows. The liquids are now typed to an Upper Cretaceous / Tertiary marine source.

A late Cretaceous source is postulated. DSP site #146 in the Venezuela deep water basin has a TOC of 4.2%. Upper Cretaceous source rocks reported in Puerto Rico have TOC values of 7%. Recent work on Jamaica has revealed the presence of Upper Cretaceous source rocks with elevated TOC's, oil shows (and gas seeps) with Upper Cretaceous affinities.

Other hydrocarbon indications include a vast sub sea oil slick reported by the National Oceanic and Atmospheric Administration, October 10th 1979, estimated to be 7 to 30 million bbls of oil. Analysis suggested it was unrefined oil.

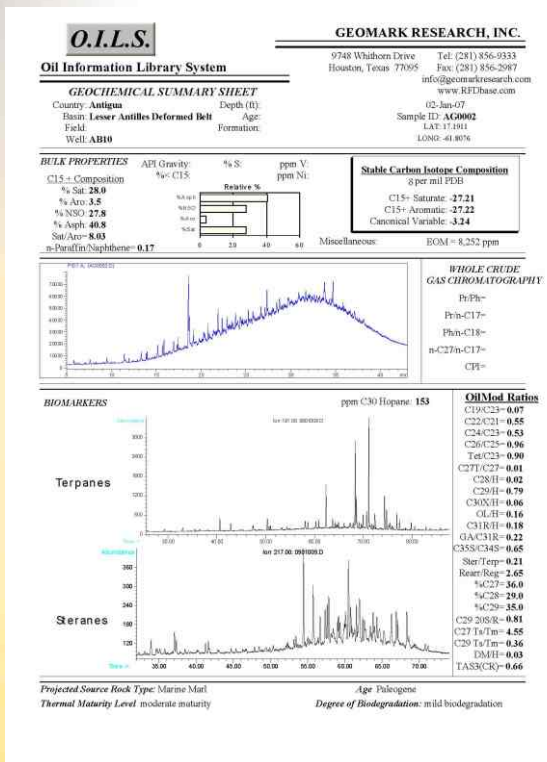
Oil show extract data for the Saba Bank wells

Saba Bank Petroleum Resources

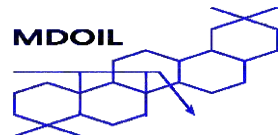
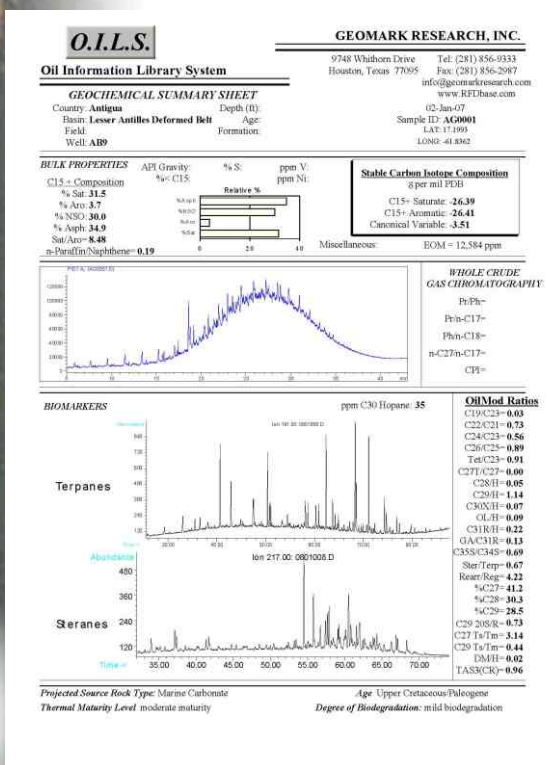
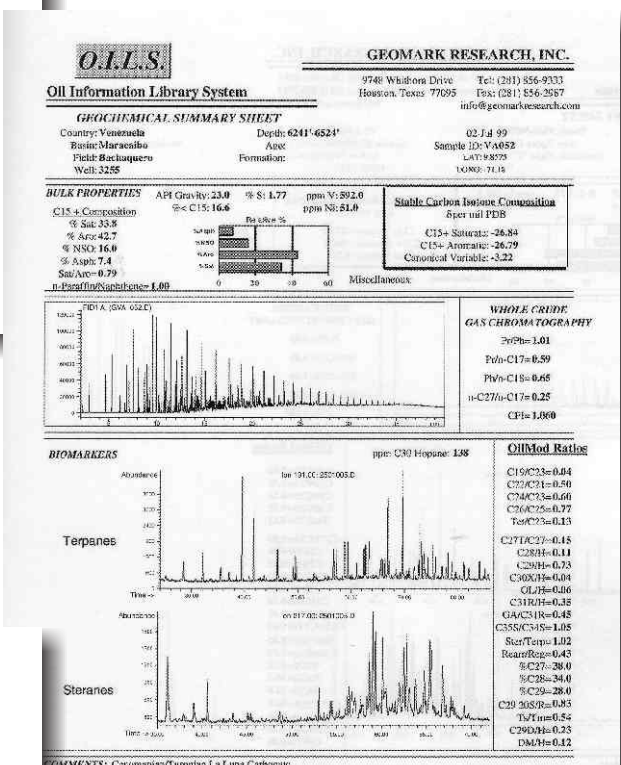


Recent petroleum geochemical analysis and interpretation

Sabal Bank Petroleum Resources



Antigua and Maracaibo Oils

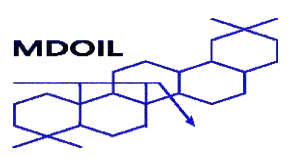
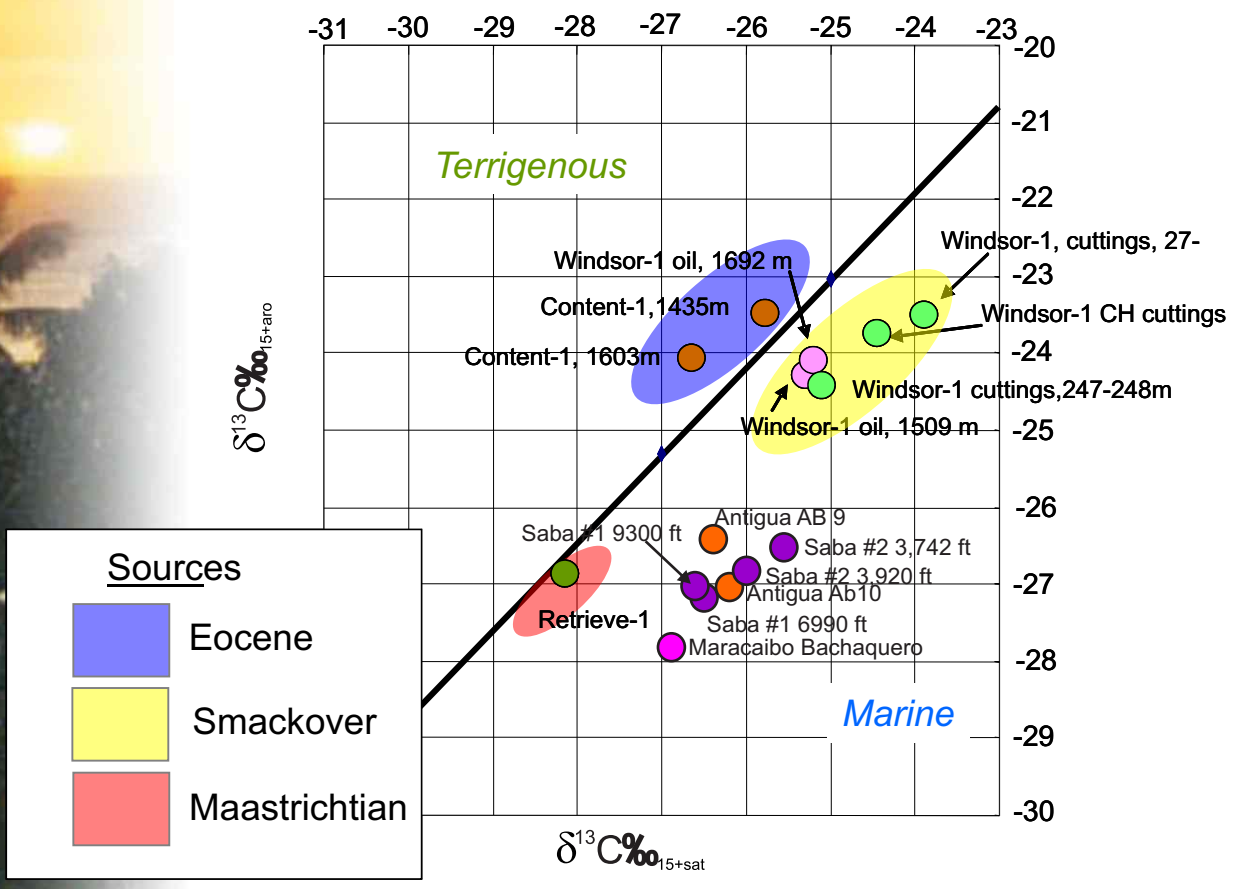


Recent petroleum geochemical analysis and interpretation

Recent geochemical analysis by GeoMark Research and by way comparison with oils within GeoMark's O.I.L.S. database it has been established that the oil shows extracted from Saba Bank #1 and Saba Bank #2 have a close affinity to oils found in wells drilled on Antigua and that these oils are derived from a marine marl source of possible upper Cretaceous to lower Tertiary age. Comparison is here made between the Saba Oils and the oil shows from Antigua and oil from the Maracaibo Bachaguero Field, Venezuela. The later is typed to the prolific La Luna source

Such rocks were not encountered by the well bore as the two wells did not penetrated the older Tertiary / upper Cretaceous.

Petroleum Geochemistry



Available Data & Reports

The Data

4,300 line km of seismic data:

United Geophysical 1970-71

USGS 1972 Sparker survey

Weeks Natural Resources GSI 1973 and CGG 1974 surveys & 1975 survey

Shell 1974 Reconnaissance survey

FINA Petroleum Survey Sint Maarten NV. 1798km. 1980 survey

Aladdin Petroleum. 343km. 1998 survey

Saba Bank Resources (Western Geophysical) 205 km. 1999 survey

Reprocessed seismic in Kingdom Suite format available via Saba Bank Resources N.V.

Paper data is available in Willemstad. Magnetic tapes are available in Denver.

Potential field data is also available.

Well data for the SB #1 and #2 wells.

Several consultant reports.

Selected papers and reports

Regional Aspects of the Cretaceous and Tertiary Evolution, Depositional History and relation to the occurrence of petroleum of the Saba Bank, North-eastern Caribbean, Ariel Jackson Warner Jr. MSc Thesis May 1991.

FINA Petroleum Sint Maarten NV Saba Bank Farmout Proposal December 1983.

Seismic Refraction and Reflection in the Caribbean Sea. N. Terrence Edgar, John Ewing & John Hennion. AAPG V55 No 6. P 833-879. 1970.

Marathon Saba Bank #1 evaluation of geology and source rock possibilities. Technical service report 1977.

The petroleum potential of the Saba Bank Area, Netherlands Antilles. Richard E Church and Kevin R Allison. Search and Discovery Article #10076. 2004.

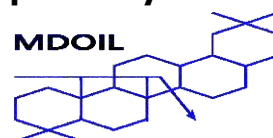
Selected references from P. Goddard Msc thesis, Saba Bank Play Diversity, 2005.

GeoMark Research O.I.L.S database 2007.

The data, reports and papers are currently being collated to produce a database to allow full assessment of this opportunity.

Saba Bank Petroleum Resources

SBPR



Concessionaire / Production License / Terms

The Saba Bank area is adjacent to Saba in the Netherlands Antilles, an autonomous part of the Kingdom of the Netherlands consisting of the Caribbean islands of Bonaire, Curacao, Saba, Sint Maarten and Sint Eustatius. Petroleum activities in the Saba Bank area are administered by Saba Bank Resources N.V., a company jointly owned by the legal entity the Netherlands Antilles and the island territories of Saba, Sint Maarten and Sint Eustatius.

The Saba Bank area is divided for licensing purposes into forty-three 7'30" latitude by 3'45" longitude blocks as shown on page two of this document. Each block is approximately 91.9 square kilometres in area.

Permit Terms

Permit terms and Production terms negotiable

Permit terms are subject to the approval by the Board of Supervisory Directors of Saba Bank Resources N.V.

Data Room

A data room will be open in London and Willemstad later this year.

Contacts

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