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Geology & Oil Potential  
of the

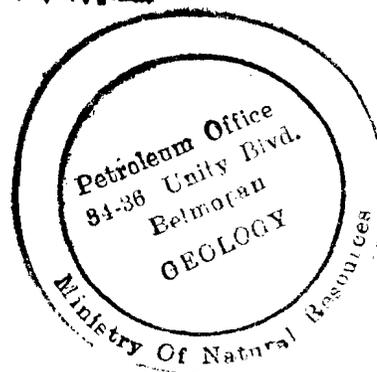
Anschutz Overseas  
Licenses

Northern Bze. - C.A.

By: D.E. Hibbard

June, 1976

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GEOLOGY AND OIL POTENTIAL

OF THE

ANSCHUTZ OVERSEAS LICENSES

NORTHERN BELIZE - CENTRAL AMERICA

D. E. Hibbard

June, 1976

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RESUME

1. Anschutz Overseas is offering for farmout a 2.8 million acre Oil Prospecting License in onshore northern Belize in Central America. A 50% working interest can be earned by drilling two wells on anticlinal prospects in the northern part of the License area where basement depths will be 7,500' to 9,000'. Total cost of this two well program is estimated to be \$2.1 to \$2.5 million.
2. Belize has a stable government and offers a safe investment climate. Terms of the Anschutz License are extremely favorable with a 12-1/2% government royalty, depletion allowance, and a maximum 50% tax rate. All obligations have been fulfilled through the Prospecting term, which extends until September, 1978.
3. Geologically, very favorable conditions exist for generation and accumulation of oil in the Lower Cretaceous carbonate-evaporite section of northern Belize.
4. Lower Cretaceous Hillbank and Yalbac dolomites are the objective reservoir units. They are direct stratigraphic equivalents to Lower Cretaceous carbonates that are prolific oil producers in adjacent portions of the basin in Peten, Guatemala and Chiapas, Mexico. They are also equivalent to Cretaceous productive units of the U.S. Gulf Coast basin.
5. The structural belt of northern Belize offers numerous anticlinal prospects that are capable of entrapping major oil reserves. These structures become more numerous and better defined in the northern part of the License area where porosity in the Hillbank and Yalbac dolomites reaches its optimum development.
6. In the northern 55 mile half of the License area, only one valid structural test has been drilled, and it had high gas logger readings and good oil shows in the samples. At least 15 sizeable anticlinal structures remain untested in this area.
7. A high gravity oil seep exists at Orange Walk in the northern part of the area. All wells drilled to date have had oil shows, including Belmopan-2 which tested 10-20 barrels of 32 degree gravity oil.
8. If one oil discovery is made, at least 12 to 15 discoveries should ultimately be made in the License area. The total oil reserve potential of these prospects is 250 to 500 million barrels.

GENERAL

Farmout Offer

The Anschutz Overseas Corporation of Denver, Colorado and its working interest partners are offering for farmout a 2.8 million acre Petroleum Prospecting License in northern Belize, Central America. Through long association with this venture, from its inception to the present, I consider this farmout offer to be an outstanding overseas exploration opportunity. My conviction on this is based on considerations of the geological merit of the area, economic potential of the play, and political stability of the Government of Belize.

Present Status of Anschutz Licenses

Anschutz controls 23 Petroleum Prospecting Licenses which include an area of 2.8 million acres. These Licenses are in the second year of a four year, extendable term, having been converted to Prospecting status from the original Exploration Licenses in September 1974. They will be converted to 30 year Mining Licenses at the end of the Prospecting term at which time a 50% acreage relinquishment will have to be made. All work commitments for the entire Prospecting period have already been fulfilled. Thus, the Licenses are valid in their present form through September 1978. Anschutz is making this farmout offer in order to broaden the exploration effort in the area with an influx of new risk capital investment. Present working and royalty interests in the area are as follows:

<u>Working Interests</u> - Anschutz Overseas-Denver	67.5%
Peoples Gas-Chicago	22.5%
Broken Hill Proprietary-Melbourne	<u>10.0%</u>
	100.0%
<u>Royalty Interests</u> - Belize Government	12.5%
Overriding Royalty Interests	<u>5.035%</u>
	17.535%

Terms of the Anschutz Farmout Offer

Anschutz is offering a 50% working interest in the entire 2.8 million acre License for the drilling of two wells to basement



on prospects in the northern part of the License area. Probable drilling depths on these prospects range from 7,500' to 9,000'. and well costs are estimated at approximately \$1 million per well. Total program costs, including rig mobilization, are estimated to be in the range of \$2.1 - \$2.5 million.

#### Physiography, Accessibility and Climate of Northern Belize

Most of the License area is comprised of low-relief rolling hills and plains with elevations generally less than 100' above sea level. To the southwest, the plains give way to high relief hills with elevations ranging up to 700-800'. Many of these hills are structurally controlled, such as the Yalbac Hills, which are the prominent surface expression of the Yalbac anticline. Further south beyond the southern boundary of the Anschutz Licenses, the Maya Mountains rise to elevations of 3,000' to 3,500' above sea level.

Vegetation over the License area varies from grasslands to semi-open pine and brush-covered Pine Ridge, to forested lowlands and dense tropical forest. In general, the open pine areas often coincide with structurally-controlled, high trends while the heavily forested areas occupy the low-lying areas between the highs. Certain areas have been extensively cleared for farming and cattle ranching, notably along the Belmopan-Belize road and in the Mennonite settlements in the northern part of the area from Orange Walk to the Mexican border. The eastern coastal plains are largely covered with swamp waters interspersed with grasslands.

Almost all of the License area is accessible by roads extending out from the port city of Belize. An all-weather highway extends westward to the capital city of Belmopan while another runs northward to the Mexican border. Numerous secondary roads branch in all directions from these highways. In the northern part of the area, many of the primary and secondary roads are built over low-relief topographic highs in order to avoid the swampy areas in the intervening lowlands. As is the case with the high-relief hills in the south, many of these low-relief topographic highs are surface expressions of gently-folded anticlinal structures.

A well-defined dry season extends from January through May of each year. The rainy season that follows has a minor dry period in mid-summer.

#### Government Relations, Currency, and Foreign Investment Risk

Anschutz Oversea's relationships with the Government of Belize have been based on mutual cooperation and respect through all exploration activities to date. The government is one of the most stable anywhere in Latin America, and it has a typical old-time British regard for sanctity of contract. The currency is stable and is part of the sterling area system. As a result, Belize is considered by the U.S. State Department as being a

country safe for U.S. overseas investment. Thus, exploratory investment is strongly regarded to be safe and free from political risk.

One potential problem, although discounted by officials in both the U.S. State department and Belizean Government, is the claim of territorial rights that Guatemala has made against Belize. However, most opinions indicate that the great differences between the two countries, i.e., racial, language, customs, economic, and religious, will completely preclude any future merger of Belize with Guatemala. Furthermore, a British Army garrison that is maintained in Belize effectly discourages any overt designs that Guatemala might make against Belize. Lastly, a majority vote by the United Nations within the past year ruled that Belize should be granted the right of self-determination and self-government.

## GEOLOGY

### Regional Geology

Regionally, northern Belize is located over part of the southern flank of the Gulf Coast basin. It has a sedimentary section of Lower-Upper Cretaceous and Tertiary formations that range in thickness from 1,500' in the south near the Maya Mountains to approximately 11,000' in the north. These sediments were deposited in a transgressive-regressive sequence over the northern Belize shelf.

The Lower Cretaceous carbonate-evaporite sediments of northern Belize are direct stratigraphic and lithologic equivalents to highly productive Lower Cretaceous sediments of the Gulf Coast basin in the United States and Mexico. Dolomites, limestones, and anhydrites make up much of the Cretaceous section over this broad area and rudistid shell remains are a characteristic fossil form. These sediments were deposited in marine embayments extending off of the overall Gulf Coast basin.

Structurally, the embayments of the Gulf Coast are separated by major uplifts and basement highs that are distributed over the entire Gulf basin. Northern Belize forms the southeastern part of a southern Gulf embayment that extends from Mexico's Jurassic salt basin into Chiapas and adjacent areas of Mexico, thence into the Peten area of Guatemala, and finally into northern Belize.

Within this southern Gulf Coast embayment, three uplifts have affected the tectonic development of the area, and have also profoundly influenced possibilities for oil migration and accumulation. These include the Chiapas uplift in Mexico, the Libertad uplift in the Guatemalan Peten, and the Maya Mountain uplift in Belize. Movements on the uplifts began in Upper Cretaceous Laramide time and have continued well into the Tertiary and even Recent. Anticlinal structures related to these uplifts extend basinward into low-lying plains areas, where

structural development is primarily in the subsurface with only minor and very subtle structural expression in Tertiary formations at the surface. It is in these anticlinal structures that are developed in a basinward direction relative to the major uplifts that the huge oil potential of the southern Gulf embayment is found. Three of these structured plains areas have been developed in the southern Gulf embayment, and are as follows:

1. Chiapas Area of Mexico

Structural folds from the Chiapas and Libertad uplifts extend northwestward beneath Tertiary formations of the coastal plains. Exploratory drilling during the past four years by Petroleos Mexicanos (Pemex) has resulted in the discovery of at least 10 billion barrels from Lower Cretaceous carbonates on these subsurface anticlinal folds. During this time, production from these prolific and still-developing fields has grown from 0 to more than 400,000 barrels per day with individual well productivities averaging 5,000 to 6,000 barrels per day. These Chiapas discoveries, now collectively called the Reforma fields, have thus developed into Mexico's most important oil discovery in the last 30 years.

2. Guatemalan Peten Basin

Anticlinal structures extend into the low-lying plains of the Peten basin from the Chiapas uplift on the west and the Maya Mountain uplift on the east. Although exploration of the basin is just beginning, a major oil discovery has now been made from Lower Cretaceous limestones on the Rubelsanto anticline, one of the many structures known to exist in the Peten. Four wells have been drilled at Rubelsanto and per well flow rates range from 2,000 to 10,000 barrels of light gravity oil per day. This important discovery is Central America's first commercial oil.

3. Northern Belize

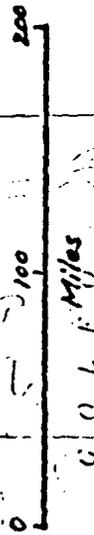
Anticlinal folds extend northeastward into the low-relief, Tertiary-covered plains of northern Belize from the Libertad and Maya Mountain uplifts. Exploratory wells drilled in this area in the past have found a prospective Lower Cretaceous carbonate-evaporite section equivalent to the section of Chiapas and Peten, and with a dolomitic reservoir development considerably better than that of the Peten. Oil shows have been found in every well drilled to date, and high gravity oil has been tested in subcommercial volumes from Lower Cretaceous dolomites in two of these wells. In spite of its promising potential, northern Belize remains to this date a pre-discovery basin.

In the remainder of the overall Gulf Coast basin, Lower Cretaceous carbonates are reservoirs for approximately 8 billion barrels of oil and 5-10 trillion cubic feet of gas in Mexico's onshore and

**Figure 2**

Tectonic Map of Bn Honduras, Guatemala, and So. Mexico  
Southern Flank of the Gulf Coast Basin

Scale  
1/5,000,000



CHIARAS, MEXICO

Cretaceous Oil Discoveries

Caetzus: 2500 - 4000 BOPD  
Site's Grande: 1700 BOPD

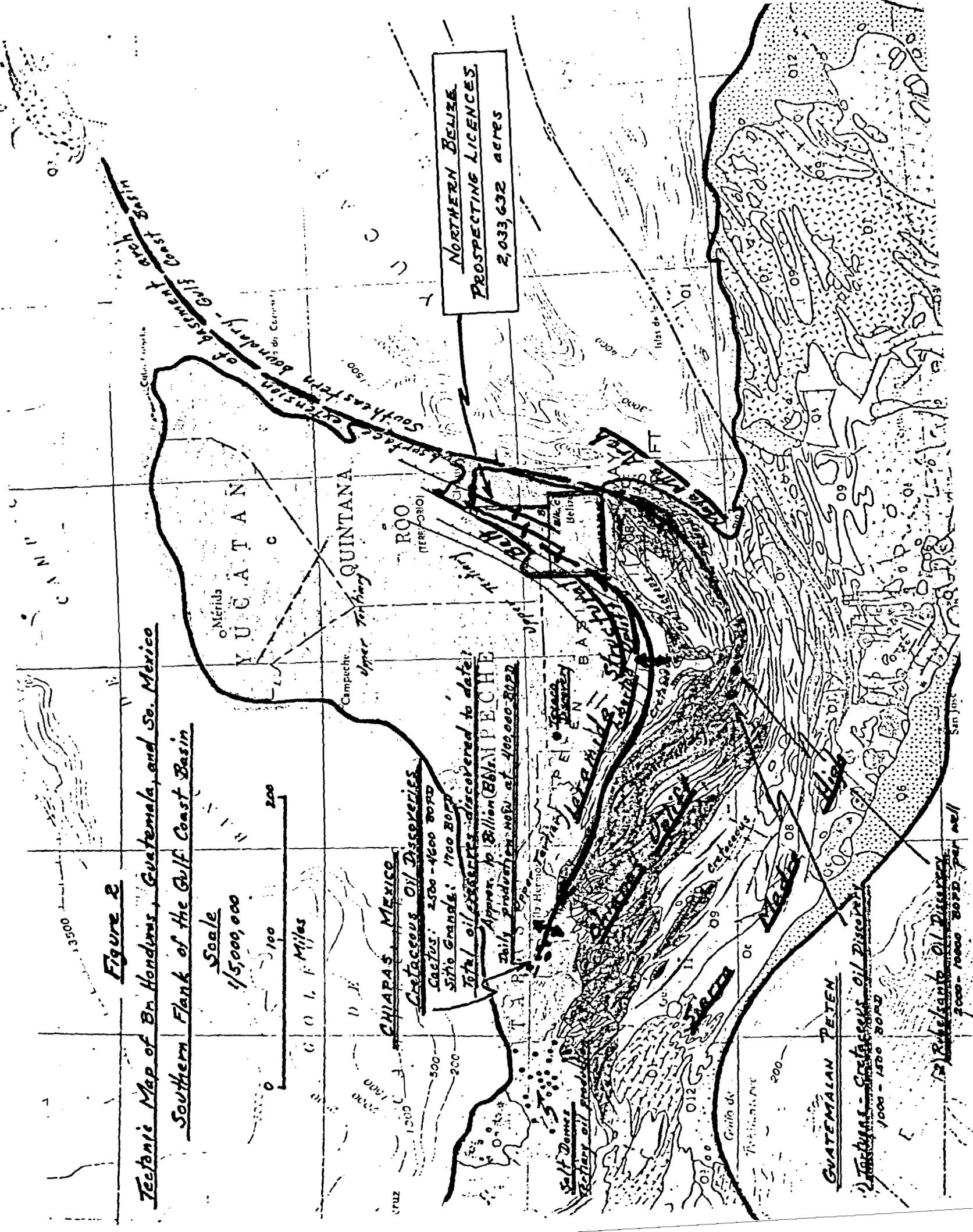
Total oil quantities discovered to date?  
Approx. 10 Billion (Bbl) MPECHE  
Daily production: 400,000 BOPD

NORTHERN BELIZE  
PROSPECTING LICENCES  
2,033,632 ACRES

GUATEMALAN PETEN

Cretaceous Oil Discovery  
1000 - 1500 BOPD

Rubelsanto Oil Discovery  
2000 - 10000 BOPD per well



marine Golden Lane trends. In the U.S. Gulf Coast, Cretaceous carbonates and clastics provide reservoirs for approximately 1 billion barrels of oil and 50 trillion cubic feet of gas. Most of these Cretaceous oil and gas accumulations of the entire Gulf Coast basin are structurally controlled. Thus, the Lower Cretaceous carbonates of northern Belize are considered to have major oil potential that is comparable to oil productivities of correlative Lower Cretaceous formations in the remainder of the Gulf Coast basin in Guatemala, Mexico and the U.S.

### Geology of Northern Belize

Geologically, the surface formations of northern Belize include upper Tertiary marls, siltstones, and beach deposits that are exposed over most of the flat and rolling lowlands north of the Maya Mountains. These overlie a thick Cretaceous carbonate-evaporite sequence in which the Lower Cretaceous carbonates and all of the interbedded anhydrites are restricted to the subsurface, thus forming a stratigraphic trap of regional proportions. To the south on the flanks of the Maya Mountains, both Upper Cretaceous limestones and Tertiary formations crop out. Basement rocks, including granite and metamorphics, are found in the core of the mountains.

### Stratigraphy

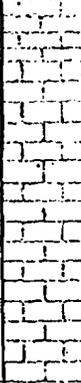
Stratigraphically, the Anschutz area of interest includes a primarily marine section of carbonates, evaporites, and lesser clastics that range in age from Jurassic to Recent. Total stratigraphic thicknesses over the License area vary from 2,000' in the south to 11,000'-12,000' in the north. These sediments were deposited over a shallow marine shelf, which occupied all of northern Belize and adjacent areas of Mexico and Guatemala. Following deposition of the Jurassic Margaret Creek clastics, Cretaceous seas transgressed over the northern Belize shelf, at which time a thick, massive dolomite, termed the Hillbank formation was deposited. The Hillbank ranges up to approximately 500' in thickness and has as much as 150' of massive, well developed, intercrystalline porosity. The Hillbank provides the most important reservoir objective in the area. Oil saturated dolomites of the Hillbank formation were cored in the Belmopan-1 well.

In a continuation of the Lower Cretaceous marine transgression, the Yalbac formation was deposited over the Hillbank. The Yalbac consists of interbedded dolomites, limestones, thin black shales and dense anhydrites, and represents the same cyclic carbonate-evaporite depositional conditions that prevailed in the Lower Cretaceous over much of the entire Gulf Coast basin. A maximum known thickness of this formation is 4,270' in the Orange Walk-1 well, of which a net 640' was porous dolomites. Both the Yalbac and Hillbank formations pinch out southward in the subsurface of northern Belize.

Dolomites in the Lower Yalbac tested non-commercial 32 degree API oil from depths of 2,000' at the Belmopan and Roaring Creek wells. Strong oil and gas shows were also found in the Lower Yalbac at the Orange Walk well. Moreover, most of the oil shows in all of the wells have been from the Yalbac. Porous dolomites of the Yalbac are thus considered to be primary

# STRATIGRAPHY OF NORTHERN BELIZE

*Thickness Range: South-2000' North-11000'*

AGE	FORMATION		LITHOLOGY	
QUATERNARY			Sands, Shales	
MIOCENE- PLEISTOCENE	ORANGE WALK		LIMESTONES- CLASTICS	OPEN MARINE
MIDDLE EOCENE	DOUBLON BANK		Limestones	Open Marine
UPPER CRETACEOUS	EARTON CREEK		Limestones	Open Marine
LOWER CRETACEOUS	YALBAC	Upper		Subtidal Dolomites
		Middle		Dolomites and Anhydrites
		Lower		Supratidal Dolomites
	HILLBANK	Dolomites, Anhydrites (Supratidal)		
	MARGARET CREEK		Continental Red Beds	
PALEOZOIC	MACAL		Metamorphosed Micaceous Shales, Quartzites	
PRE-PALAEZOIC	GRANITE			

reservoir objectives in northern Belize. Water tested from both the Yalbac and Hillbank dolomites is highly saline in nature, ranging up to 130,000 parts per million.

Following the restricted and cyclic carbonate-evaporite deposition of the Lower Cretaceous, shallow marine, shelfal conditions prevailed during the deposition of the Barton Creek limestones in the Upper Cretaceous. These conditions continued through the Tertiary when a sequence of shelf limestones and clastics were laid down over northern Belize. Deposition ended with regression of the seas from the area in late Tertiary and Pleistocene time. Thicknesses of the combined Tertiary and Upper Cretaceous formations range from 1500' to 3,000' in the wells drilled in the area. This section is generally considered non-prospective since most of the porous limestones are fresh water bearing. However, this section does provide stratigraphic cover and a seal for the underlying prospective Lower Cretaceous formations.

#### Source Rock Potential - Paleotemperature Analysis

In November 1972, the English company Robertson Research International Ltd. analysed core samples from the Belmopan and Lemonal wells for an evaluation of source rock potential and maximum paleotemperatures. The source rock potential was defined as the potential of the rocks to generate sufficient hydrocarbons for migration to produce commercial oil fields, while the maximum paleotemperature evaluation was to determine possible generation of oil vs. generation of dry gas vs. non-generation of hydrocarbons. In all samples analysed for the two wells, the quality of the source rock potential was regarded as good. In the paleotemperature analysis, it was concluded that the samples from both wells fell clearly within the zone of commercial oil potential. Therefore, these analytical tests on the Lower Cretaceous sediments provide evidence of a favorable source potential in the area. In addition, the many oil shows and recovery of 32 degree API oil are positive proof of oil generation in the basin.

#### Reservoir Potential

All porous dolomites of the Lower Cretaceous in northern Belize pinch out updip in the subsurface southward toward the Maya Mountain arch. Thus, the reservoir potential of the Hillbank and Yalbac dolomites has been defined entirely from subsurface well data. The thick, massive dolomitic porosity in the Hillbank formation is obviously the most important reservoir objective in the entire section. If found to be oil bearing within structural closures, this thick dolomite could have a very high reserve potential based on a very favorable per-acre oil recovery. A maximum development of 145' of massive porosity in a gross dolomite section of approximately 500' was penetrated in the Orange Walk-1 well.

From subsurface well data, it appears that the most favorable zone of Hillbank porosity is in a minimum 65 mile long north-

south zone extending from Belmopan on the south through the Orange Walk area on the north with the porosity development increasing northward. (See Table 1) The northern limit of this zone is unknown since no further well control exists beyond Orange Walk. The east-west limits of this favorable zone lie somewhere between the Blue Creek and London wells, with the Tower Hill and Orange Walk wells falling within the zone of best development. (See Table 2)

As with the Hillbank, porosity development of individual dolomite units in the overlying Yalbac formation generally increases northward over the northern Belize shelf. In addition, the cumulative thickness of porous dolomites within the Yalbac increases significantly to the north (See Table 1).

Based on these data, it is concluded that the reservoir character of both the Hillbank and Yalbac dolomites is best developed in the northern part of the Anschutz License area. It is of considerable interest to note that both the thickness and magnitude of Lower Cretaceous porosity development in northern Belize are considerably more favorable than the reservoir conditions of equivalent units that are oil bearing in the Guatemalan Peten.

#### CONSULTANT'S INTERPRETATION OF LOWER CRETACEOUS STRATIGRAPHY AND ITS RELATIONSHIP TO OIL POTENTIAL

In order to obtain an outside, completely impartial interpretation of the prospects in northern Belize, a consulting geologist who is completely familiar with Gulf Coast geology was retained. Exerpts from the report of Mr. Leo A. Herrmann, Ruston, Louisiana, dated September 1972, are as follows:

"Examination of cores, samples and thin sections on the subject exploratory tests drilled in British Honduras leads me to believe the Lower Cretaceous rocks are highly potential targets for further exploration....."

".....the presence of miliolids and orbitilinas indicate a Lower or Middle Cretaceous age. These forms are typically found in the Gulf Coast region in rocks of the Coahuilan and Comanchean Series (Sligo to Washita-Fredericksburg interval). The presence of anhydrites in the Yalbac and the occurrence of massive dolomite in the Hillbank reminds one of the Mooringsport-Ferry Lake over Rodessa sequence of the Gulf Coast region. On this basis, we might tentatively assign the Yalbac to the Mooringsport-Ferry Lake interval, and the Hillbank to the Rodessa. The Hillbank might be as old as Sligo, but it more logically fits the Rodessa interval."

"The abundance of anhydrite and dolomite in the Yalbac and Hillbank intervals would seem to indicate a slowly sinking, restricted basin during Lower Cretaceous time .... The presence of

TABLE I

NORTHWARD DEVELOPMENT OF LOWER CRETACEOUS POROSITY

	<u>SOUTH</u>				<u>NORTH</u>
<u>Yalbac Formation</u>	<u>Belmopan-1</u>	<u>Rancho Dol-1</u>	<u>Lemonal-1</u>	<u>Tower Hill-1</u>	<u>Orange Walk-1</u>
Total Porosity Thickness	28'	399'	510'	?	639'
Porosity Range	6-10%	5-23%	6-22%	?	6-30%
<u>Hillbank Formation</u>					
Massive Porosity Thickness	31'	55'	126'	140'	145'
Porosity Range	6-11%	5-6.5%	6-13.5%	?	6-18%

TABLE 2

EAST-WEST DEVELOPMENT OF LOWER CRETACEOUS POROSITY

	<u>WEST</u>				<u>EAST</u>
<u>Yalbac Formation</u>	<u>Blue Creek-1</u>	<u>Orange Walk-1</u>	<u>Tower Hill-1</u>	<u>London-3</u>	<u>Basil Jones-1</u>
Total Porosity Thickness	?	639'	?	182'	?
Porosity Range	?	6-30%	?	7.4% (Aver.)	?
<u>Hillbank Formantion</u>					
Massive Porosity Thickness	40'	145'	140'	38'	75'
Porosity Range	?	6-18%	?	7.2% (Aver.)	?

questionable oolites also enhances the possibility of fairly high energy conditions which are necessary for the growth of reefs."

Thus, geologists who are familiar with the Gulf Coast are impressed by the similarities of the stratigraphy of the Gulf Coast and northern Belize, and share the same opinion that "the Lower Cretaceous rocks are highly potential targets for further exploration."

### STRUCTURE

The Anschutz Licenses cover the entire shelfal portion of the basin north of the Maya Mountains uplift. Regional dip of the Cretaceous-Tertiary sediments over the shelf is a gentle 1-3 degrees north and northwest to the Mexican border. Although not conclusive, subsurface data from the Blue Creek well indicate that a NE-SW trending Lower Cretaceous hinge line may exist along the Mexican-Belizean border, northwest of which the section thickens and porosity decreases.

In the southwestern part of the License area at the border between Belize and the Guatemalan Peten, the Libertad uplift plunges northeastward towards the northern Belize shelf. The strongly-expressed Yalbac anticline, which is eroded into the Cretaceous, is the last prominent structural expression of this uplift before it plunges into the subsurface of the basin and is covered by Tertiary formations. From there, the subsurface projection of the Libertad uplift extends northeastward across the northern Belize shelf in a 90 mile long zone of very gently folded, mildly expressed anticlinal and faulted structures. Commonly, but not always, the structures are related to extensive up-to-the-basin longitudinal faults that cut through to the surface, controlling the courses of the long, linear, NNE-flowing rivers in northern Belize.

Anticlinal trends in this structural zone range up to 25 miles in length. In the northern part of the area, the trends appear to break up and individual anticlines of up to 10 miles in length have been mapped. The anticlines are mildly asymmetric with the regional west flank having 1-3 degree dips while dips on the critical east flank average from 2 to 5 degrees. Overall, these individual anticlines and anticlinal trends have been developed into a structural zone 90 miles in length and 15-20 miles in width.

The structural zone was originally defined photogeologically as an anomalous trend of low relief topographic highs and geomorphic features. These features were interpreted to be anticlinal structures because of their close association with clearly-defined, folded Tertiary sediments that could be seen on the photos. Structural confirmation was ultimately provided by field mapping which showed dip reversals with flank dips averaging 2-3 degrees and ranging up to 5-7 degrees over

six of the geomorphic features. In addition, further confirmation has been provided by seismic data, although the quality of seismic reflections is generally poor in northern Belize.

This structural zone crosses the Northern Belize shelf with its cyclic reservoir and source deposits of porous dolomites, thin black shales, and impervious anhydrites. At least 20 to 25 faulted anticlinal structures have been mapped in this zone over the entire length of the License area. The size of these structures would indicate a reserve potential for individual prospects varying from 25 to 75 million barrels each. It is in these numerous structural prospects that the large oil potential of the basin is found. If one commercial oil discovery can be made, it is estimated that at least 10 to 15 oil discoveries will ultimately be made in the Anschutz License area. The total oil reserve potential of these discoveries could easily be 250 to 500 million barrels, or even more under very favorable geologic conditions.

#### MANIFESTATIONS OF OIL AND GAS

Indications of oil and gas give positive proof that hydrocarbons have been generated in northern Belize. At least five oil seepages have been found along the southern updip margin of the basin on the flanks of the Maya Mountain uplift. Northward at Orange Walk where stratigraphic thicknesses are approximately 8,000', a live seepage of light gravity oil has been found where a fault cuts through to the surface. Droplets of oil come to the surface of the river and quickly spread into an oil sheen on the water. In addition, oil shows have also been found in almost every well drilled through the Lower Cretaceous. In particular, the Anschutz Belmopan-2 well tested 10-20 barrels of 32 degree API oil from a lower Yalbac dolomite and the Belmopan-1 well cored 80' of oil-saturated dolomites in the lower Yalbac and upper Hillbank formations. Gulf's Roaring Creek-1 also recovered about 10 barrels of oil from the lower Yalbac formation. To the north, the Anschutz Orange Walk-1 well penetrated oil-bearing dolomites in the lower Yalbac and recorded high gas logger readings over part of the Lower Cretaceous section. Although the latter well tested salt water, it is strongly suspected from the increasing gas readings on the mud logger that the well was drilled on the edge of an oil accumulation. On the San Pablo prospect, H<sub>2</sub>S gas was found at shallow depths. This led to abandonment without even reaching the prospective Lower Cretaceous section, which is unfortunate, since H<sub>2</sub>S gas is commonly associated with oil in the Southern Gulf Embayment.

#### ANALYSIS OF GEOLOGICAL AND EXPLORATION RESULTS TO DATE

Table 3 lists all exploratory wells drilled within the area of the Anschutz Licenses during the past 25 years. Eight of the Gulf wells that are located within the License area, plus one outside, were drilled during the 1950's. All of these wells were located on gravity anomalies, since the seismic data at that time were too poor quality to define structures, according to Gulf geologists who were associated with the project. All were abandoned as dry holes with only the Roaring Creek well testing subcommercial oil.

TABLE 3

EXPLORATORY WELLS - NORTHERN BELIZESOUTHERN AREA - Basement Depths 1500' to 6000'

<u>OPERATOR</u>	<u>WELL</u>	<u>PROSPECT &amp; GEOL./GEOPHY. BASIS</u>	<u>RESULTS</u>
Gulf	* Roaring Creek-1	Belmopan anticlinal reversal seismic & photogeology	+ Tested 10 Bbls. oil from Yalbac dolomites.
Gulf	Retaliation-1	Gravity anomaly	Oil shows.
Gulf	Hillbank-1	Gravity anomaly	Oil shows.
Gulf	Sand Hill-1	Gravity anomaly	Oil shows.
Gulf	Yalbac-1	Complex faulted surface anticline	Oil shows.
Anschutz	* Belmopan-1&2	Belmopan anticlinal reversal-seismic and photogeology	+ Oil saturated Yalbac and Hillbank dolomites. Tested 10-20 Bbls. oil.
Anschutz	Belmopan-3	Electrical anomaly	Minor oil shows.
Anschutz	Rancho Dolores-1	Faulted anticlinal flank-seismic & photogeology	Oil shows.
Anschutz	Lemonal-1	Photogeologic & gravity anomaly	Oil shows.

NORTHERN AREA - Basement Depths 6000' to 11000'

Gulf	Blue Creek-1	Gravity anomaly	Oil shows.
Gulf	Tower Hill-1&2	Gravity anomaly	Oil shows
Anschutz	London-1,2,3	Weak seismic terracing	Minor oil shows. Wells 1&2 were lost holes at shallow depth.
Anschutz	* Orange Walk-1&2	Photogeologic/surface reversal w/ residual gravity anomaly	+ Good gas & oil shows from mud logger and samples.
Anschutz	San Pablo-1	San Pablo anticline-seismic, photogeologic, surface reversal w/ residual gravity anomaly	H <sub>2</sub> S gas at shallow depth. Abd. at 3455' w/ ± 5000' of L. Cret. section remaining untested. Inconclusive test.

## NOTE:

\* Considered valid test of anticlinal reversal.

+ Best quality oil shows, far superior to other wells.

The Anschutz wells were located on a variety of geophysical and geological evidence, including seismic, gravity, electrical surveys, photogeology and surface geology. Subcommercial oil was tested at Belmopan-2 and oil-saturated Yalbac and Hillbank dolomites were cored at Belmopan-1. Orange Walk-1 had the strongest gas readings from mud logger of any well in northern Belize and San Pablo-1 is the only well to have found H<sub>2</sub>S gas in the entire area.

Of the Anschutz wells described above that had good oil and gas shows or H<sub>2</sub>S gas, all had one other common characteristic. All were located on structural reversals that had positive confirmation of critical counter-regional dip from seismic data or surface geology. Other Anschutz wells had only poor to fair oil shows as a result of drilling on gravity or fault trap anomalies that never had confirmation of critical counter-regional reversal.

While the drilling to date has not resulted in any commercial oil discoveries, it has at least confirmed the existence of geological characteristics necessary for oil entrapment in known oil-productive basins. These characteristics include the presence of valid oil and gas shows, proven anticlinal structure, reservoir facies, and source facies. In addition, the presence of evaporites in the prospective Lower Cretaceous section is highly favorable since it is evidence of a reducing, oil-generative environment of deposition, while at the same time, it provides a trapping seal for migrating hydrocarbons. In a regional consideration also, the proximity of the major oil discoveries of Chiapas, Mexico and Peten, Guatemala suggest that it is only a matter of time until oil discoveries are made in the northern Belize part of the basin as well. As far as can be recalled, there is not a single basin worldwide where such a combination of favorable geologic relationships together with valid high gravity oil shows, has not ultimately resulted in commercial oil discoveries.

#### EVALUATION OF REMAINING PROSPECTS

Numerous untested prospects remain in the Anschutz License area. In fact, in the northern half of the License, which covers a distance of 55 miles, there are 15 or 16 undrilled structural prospects. Furthermore, in this entire area, there is only one valid structural test, Orange Walk-1, and that well had strong gas logger and oil shows from the Yalbac section. With the valid shows of oil and H<sub>2</sub>S gas in northern Belize, it is strongly believed that at least two or three additional prospects should be tested. Important prospects to be considered include the following:

##### San Pablo Anticline

The San Pablo anticline is considered to be the most important prospect in northern Belize because of its large size (6 x 2 miles), its broad symmetrical form, its well-defined critical east flank, and its confirmation by both surface geologic mapping and limited seismic coverage. One test has already been drilled on the prospect, but it was

abandoned at the shallow depth of 3,455' because of H<sub>2</sub>S gas without testing the remaining 5,000' of prospective Lower Cretaceous section overlying basement.

Based on a per-acre recovery of 10,000 barrels of oil (100' of pay and 100 bbls. per acre foot), the San Pablo Prospect has a reserve potential of approximately 75 million barrels of oil. A road exists to the recommended location. This prospect should definitely be tested by one of the two wells in the farmout drilling program. Granitic basement is estimated at a depth of 8,500'. P. 100  
P. 64/107

#### Patchachacan Prospect

This prospect is a 10 mile long by 1-1/2 mile wide anti-clinal structure, as mapped by surface and photogeology. In addition, the structure is expressed as a broad, low relief, topographic high. Dips of 1 to 4 degrees have been mapped on the flanks of the structure and confirmation of the anticlinal reversal is provided by the one seismic line that crosses the prospect. Basement depth is estimated at 8,500' to 9,000'. A road exists to the recommended location. The total reserve potential of the Patchchacan Prospect is estimated to be 65 million barrels of oil. S. 90  
P. 10  
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#### Guinea Grass - San Jose Palmar Prospect

This 15 mile long structural trend is clearly-defined by outcropping beds of Tertiary formations that have been mapped by photo and surface geology. An up-to-the-basin fault bounds the structure on the east side and provides additional closure in that direction. The overall structure is divided into two closures by an intermediate structural saddle with Guinea Grass being a stronger closure than San Jose Palmar. Critical closure to the south is provided by positive south plunge, as shown by surface geology and seismic data. A high gravity oil seepage exists at Orange Walk on the northern end of the structure and another seep has been reported just south of Guinea Grass. The Orange Walk wells were drilled on-trend to the north of this prospect. A road exists to possible locations on both the Guinea Grass and San Jose Palmar prospects. Potential reserves are estimated at 40 million barrels per prospect or 80 million barrels for the entire structural trend. Basement depth is estimated at 7,500'. 11.00  
P. 10

#### Progreso Prospect

The Progreso Prospect is similar in size and shape to the San Pablo Prospect, but is developed in a shallower and more updip portion of the northern Belize shelf. It is well defined by both photo and surface geology, and is strongly supported by a residual gravity anomaly. Basement depth is estimated to be approximately 8,000'. The prospect has a reserve potential of 75 million barrels. Some minimal road work would be necessary to reach the recommended location. 11.00  
P. 10

