

# **Treaty Energy Corporation Princess Petroleum Belize Joint Venture**



Preliminary Evaluation of the Potential for Oil  
within the Treaty Energy/Princess Petroleum Blocks  
in Belize

- General review of geologic criteria favoring the presence of petroleum;
- Review of the petroleum geology of the Yucatan;
- Belize geology;
- Specific characteristics of the Princess Blocks that favor the presence of petroleum;
- Conclusions;
- Recommendations for the next phase of investigation including costs.



- Source
- Reservoir
- Seal
- Trap
- Maturation, and
- Migration



- Yucatan Peninsula is partitioned among Mexico, Guatemala and Belize.
- Major oil discoveries have been made within the Yucatan area. Much of the geology of Belize, especially in the northern half of the country, is a southward extension of the geology of the Yucatan. Petroleum deposits in south-eastern Mexico and Guatemala occur in two main geologic provinces, the Gulf Coast Tertiary basin area and the Peten Basin.
- Major oil production is from intensely micro-fractured Paleocene, Cretaceous, and Jurassic carbonate reservoirs. Several small oil fields have been discovered in Cretaceous carbonate reservoirs in west-central Guatemala, and one major discovery has been reported in north-western Guatemala. Small- to medium-sized oil accumulations also occur in Miocene sandstone reservoirs on salt structures in western Tabasco State, Mexico.
- The Yucatan Peninsula holds the largest concentration of giant oil and gas fields in the Western Hemisphere.
- Large portions of the peninsula remain underexplored. The focus has been to explore for very large fields, and many mid and small size areas have been ignored.

**The Chicxulub Crater is an ancient impact crater buried underneath the Yucatan Peninsula. The crater is more than 180 kilometers in diameter, making it one of the largest confirmed impact structures in the world. The microfracturing of rock caused by the impact created an extremely favorable environment for the trapping of petroleum. It is likely that some degree of microfracturing caused by the impact extends into Belize and beyond southward i.e. into Honduras, Nicaragua and San Andres and Providencia seashelf.**

**The similarity of the geology of Belize to that of oil-producing areas of Mexico and Guatemala prompted oil companies, principally from the United States, to explore for petroleum at both offshore and on-land sites in the early 1980s.**

**Recently, production wells have been successfully drilled on land in the west central portion of Belize. The combined production of these wells is almost 3,000 barrels a day of sweet crude that is so low in sulphur that some farmers pump it directly into their tractors.**

**A detailed description of the petroleum geology of this area is contained in the document entitled: “Petroleum Geology and Resources of Southeastern Mexico, Northern Guatemala, and Belize” by James A. Peterson which is contained in the Attachment.**



# Geology of Belize



The geology of Belize, which is similar to that of the remainder of Yucatan, consists primarily of limestone, with the notable exception of the Maya Mountains, a large intrusive block of granite and other Paleozoic sediments that run northeast to southwest across the south-central part of the country.

Several major faults are present in the highlands of the Maya Mountains. The micro-fracturing present under the Yucatan is known to extend into Belize.

Much of the northern half of Belize lies on the Yucatan Platform, a tectonically stable region. Alluvial deposits cover the relatively flat landscape of the coastal plain. Figures 2 through 4 are geologic maps of Belize. Attached maps showing the geology of the Princess Blocks. Significant faulting is shown within the blocks.

### MAP LEGEND

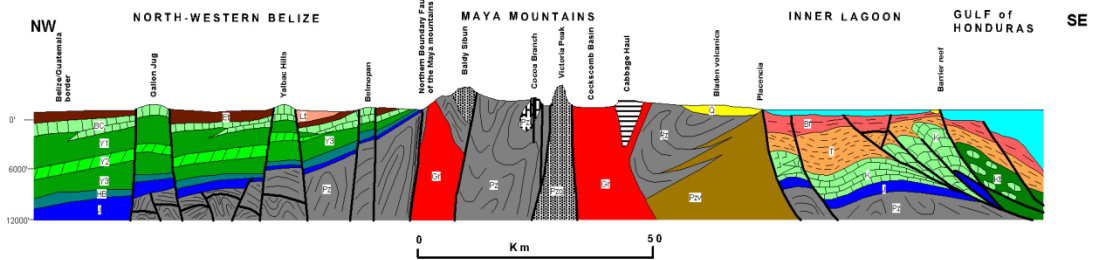
	Quaternary Alluvium & modern reef		Fault lines
	Late Tertiary -Red Bank & Orange Walk Groups Clays, gypsum, sand, chert, marl, limestone		Formation boundary
	Oligocene(?) -Guana Creek Fm Carbonate-chert conglomerate		Drainage
	Early Tertiary -El Cayo Group-Doubton Bank Fm (limestone, marl, gypsum, chert nodules)		Road
	Undif. Cretaceous -Barton Creek Fm(BC)/Campur Fm Limestone, dolomite -Coban Fm (dolomite)		Subsurface-northern Belize (Coban Fm Equivalents)
	Jurassic (?) -Margaret Creek/Todos Santos Fm Shales, sandstones. -Also Late Jurassic (Tithonian) to Neocomian pelagic carbonates outcropping in hills near Punta Gorda (400' of salt encountered in the Punta-Gorda-1 well are most likely Jurassic in age)		V1: Anhydrite-dolomite alternations
	Late Silurian or Late Triassic (?) Plutons Mountain Pine Ridge pluton (diorite-granodiorite, granodiorite, quartz monzonite, granite and muscovite granite) Hummingbird-Mulins River pluton (bi-mica granite, granodiorite and quartz monzonite). Cockscomb-Sapote pluton & stock (porphyritic biotite granite)		V2: Dolomite-(anhydrite)
	PERMO-CARBONIFEROUS SANTA ROSA GROUP		V3: Anhydrite-dolomite alternations
	Shales, argillites, slates, schists, phyllites, (sandstones)		Hill Bank Formation (Early Cretaceous) Dolomite-(anhydrite)
	Quartzites, sandstones, conglomerates		
	Crinoidal limestones		
	"Bladen Member" volcanic rocks, lavas & pyroclastics, rhyolitic to andesitic volcaniclastics		
	Gn Gneiss/schist/clastic rocks of unknown age (Precambrian?-Early Paleozoic?)		
	Schists, slates w/ contact metamorphism minerals (garnet, tourmaline, andalusite(chestobite), staurolite) note: andalusite and tourmaline may have a (late Triassic) hydrothermal instead of a contact metamorphic origin. All the plutons may be of Late Silurian age, predating the deposition of the Santa Rosa Group (Steiner et al. 1998).		

SOURCES FOR THE MAP COMPILATION ARE FROM THE FOLLOWING PIONEERS:  
 AXIAX & AREL CO, 1970; BATESON & HALL, 1958; BRYSON-ANSCHUTZ, 1974-75; COLE-ANSCHUTZ, 1978; GURCH & GLAUSS-SHELL, 1967; DEPRETIS-PLACID, 1970; DERRY & THOMPSON, 1968; DILLON-JONES, 1973; DIXON-GOD, 1956; DRUEKER-ANSCHUTZ, 1976-78; FLANDERS-ANSCHUTZ, 1978; FLORES-BAHAMAS CO., 1952; GALLO & MUELLER-ESSO, 1966; GEOPHOTO SERVICES, 1958; LAMERSON-CHEVRON, 1971; MILLER-BAHAMAS CO., 1960; R. HARDY, OXY-CITIES SERVICES, 1963; PECTEN, 1983; SHIPLEY-ANSCHUTZ, 1977; SHAFER-ANSCHUTZ, 1976, T.G.A., 1971; THORSON-ANSCHUTZ, 1978; BLACK LAKE-PARKMORE, 1985; WRIGHT & AL., 1968.

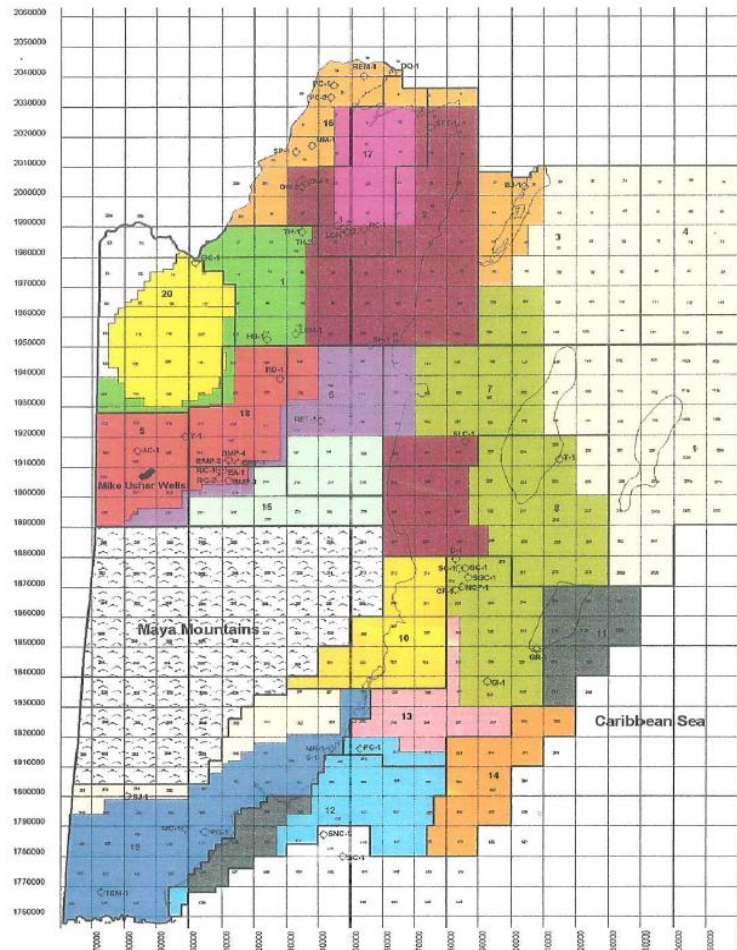
NATURAL RESOURCES POTENTIAL:  
 PETROLEUM: OIL (AND GAS) SEEPS AND OIL SHOWS IN EXPLORATORY WELLS IN NORTH-CENTRAL BELIZE AND TOLEDO. NUMEROUS TAR BALLS NEAR ROCKY POINT (AMBERGRIS CAYE) AND UNDERWATER SEEPS OFF COLUMBUS REEF.  
 28" UP TO 41" API OILS IN BELMOPAN WELLS AND 20" API OIL IN GALLA CREEK.  
 BASE (LEAD, ZINC, TIN, MOLYBDENUM, BARIUM) AND PRECIOUS METALS (PLACER AND LODGE GOLD, SILVER) IN THE MAYA MOUNTAINS.  
 INDUSTRIAL MINERALS IN NORTH-CENTRAL BELIZE AND TOLEDO DISTRICT:  
 LIMESTONE, DOLOMITE, CLAYS, GYPSUM, IRON, DIATOMITE, PHOSPHATE (BAT GUANO).

Map, cross-section and legend compiled by Jean H. Cornec, 2003. jcornec@aol.com

### NW-SE DIAGRAMATIC CROSS-SECTION



# Belize Petroleum Contracts Map



## LEGEND

West Bay Belize Ltd.	SOL Oil Belize Ltd.
RSM Production Corporation	PetroBelize Ltd.
Belize Natural Energy Ltd.	
Island Oil Belize Ltd.	
US Capitol Energy Belize Ltd.	
Spartan Petroleum Corporation	
Perenco Ltd.	OPIC Permit Area
BelGeo Ltd.	
Providence Energy Belize Ltd.	
Blue Creek Exploration Ltd.	
BCH International, Inc.	
ZMT International, Inc.	
Miles Tropical Energy Ltd.	Vacant Blocks
Princess Petroleum Ltd.	Exploration Well (approximate location)
	Production Well (Spanish Lookout Oil Field)

**KILOMETRES**  
 0 10 20 30 40

Each Block shown is 10km x 10km in size with an area of 100 square kms and is subdivided into 25 Sub-blocks labeled A to Y each 2km x 2km in size with an area of 4 square kms.

Exploration Blocks are numbered for application purposes only.

Prepared by the Geology and Petroleum Department, Ministry of Natural Resources and the Environment, Government of Belize  
 Updated October 2007  
 Property of the Geology and Petroleum Department

# Favorable Characteristics of the Treaty/Princess Blocks

- Our review of the available information shows that the geology of the Yucatan Peninsula, which has produced large oil fields, extends southward into Belize.
- The geographic size and location of the Princess concession off the northeast coast of Belize very favorable.
- Within the Princess Blocks, there are sedimentary rocks of Upper Cretaceous age up to Tertiary age that could contain oil reserves. Of greater importance are the Paleocene to Upper Tertiary formations. We anticipate thick Tertiary formations in the off-shore blocks. Unfortunately, little to no geologic information is available from previous off shore exploratory drilling programs.
- Fracturing of the rock, which provides a favourable environment for oil, is present and increases from west to east across Belize, including the on land and off-shore areas. For the on land blocks, the potential for oil increases from very low toward the west (toward the Maya Mountains) to favorable toward the east. There is a continuation southward into Belize of the microfaulting created by the Yucatan impact crater.
- Most of the faulting in the on land blocks is normal faulting; however, some reverse faults can be seen on the geologic maps.
- The reverse faulted areas have potential for large quantities of oil because of potential duplication of the sedimentary sequence, offering more volume to potential reservoirs.
- There are several folded structures in the on land blocks that close eastward, including a potential flexure increasing the thickness of the sedimentary rocks of Tertiary age from 250 meters to possibly 500 to 600 meters.
- There may be a considerable amount of evaporites in the area that can serve as cap rock, but they need to be defined in both thickness and areal extension.

# Conclusions



There is substantial potential for oil in both the on land and offshore (sea shelf) blocks of Princess Petroleum. The four scenarios and other conclusions below are based on our review of available geologic data for Belize and the expectation that Belize structures are the extension of the Mexican structures from the northern part of the Yucatan Peninsula.

**Pessimistic Scenario**-there is no oil or gas. In all oil exploration, there is risk, and this scenario must be considered.

**Average Scenario**-4 to 15 million barrels of oil plus and undetermined amount of natural gas. The quality will most probably be low-sulfur crude, similar to that of Spanish Lookout (Belize Natural Energy Limited).

**Optimistic Scenario**-10 to 30 million barrels of oil plus an undetermined amount of gas. Quality the same as for the Average Scenario. (This scenario is based on the Princess concession having characteristics similar to that of the Campeche Bank of western Yucatan. We calculated an area of 5 square kilometers of 70% API 20, with 92% petroleum plus 4% gas and 4% water in a micro-fractured block.)

**Cannot-be-ruled-out Scenario**-if micro-fracturing is found to be two time what we anticipate, the amount of oil could increase by a factor of six.

# Conclusions



- Estimates for the sea shelf are for 50% of the expectation per acre for the on land blocks. The estimate includes both shallow intersections and mid-depth intersections of up to 3,300 feet in depth.
- Our opinion is that the potential for mid-size oil and gas deposits in Belize has been underestimated and that some oil companies have become discouraged because they had expectations of giant deposits such as those in Mexico.
- The sea shelf in Caribbean Central America is an area of high potential for oil and gas as is an extension of the Gulf of Mexico deposits; however, the specific structural patterns present are more conducive to smaller, but very promising mid-sized deposits.
- Recommend Belize-size deposits for small to medium-size companies because they can be managed without insurmountable challenges.
- Additional oil discoveries in Belize would be an economic boost to the country.
- Concerns that the government will mismanage the resource and allow the new oil industry to destroy Belize's pristine wilderness. Social and political issues must be dealt with very carefully.

# Recommendations for the Next Phase of Investigation



Oil and gas exploration can be risky and is expensive. A phased approach is recommended to minimize costs while the risk is still present.

After the preparation of 1:25000 scale geological mapping and evaluation of available remote sensing information, a reasonable go-no go decision can be made. Then, more serious funds can be invested in seismic surveys, significant savings can be realized by using available and proven technologies such as inclined drilling from the shore to explore off shore areas.

Recommendation for the next phase of investigation is to prepare the 1:25000 scale geologic model of the Princess Blocks. This will involve the following studies:

Task 1: Create a remote sensing and geophysics model of the area at a 1:10,000 scale. This will be provided as an adjusted composite set of existing geological, satellite imagery and geophysics maps, and

Task 2: Geologic/Structural mapping at a 1:25000 scale.

**Identification and definition of folds (anticlines and synclines) and other folded and faulted structures, with potential for increased sedimentary thickness, mainly of tertiary age. It should include both large and midsize structures (more than 150 meter strike-length).**

**Identification and definition of lithologies of the Tertiary sedimentary units, the current definition of “limestone” is very vague and not completely correct.**

**Identify surface hydrocarbon (including asphalt) occurrences or material such as black carbonaceous shale, etc.**

**Define the priority areas for 2D geophysics in a later phase of work.**

**Have a 1:25,000 geologic map and all the info necessary to report to the local agencies in Belize.**