[PS]Phenomenon of the Albian Cenomanian Turonian Source Rock in the Suriname Part of the Guiana Basin*

Clyde P. Griffith[1]

Search and Discovery Article #11226 (2019)**
Posted July 15, 2019

*Adapted from poster presentation given at 2018 International Conference and Exhibition, Cape Town, South Africa, November 4-7, 2018
 DOI:10.1306/11226Griffith2019

[1]Petroleum Contracts, Staatsolie Maatschappij Suriname NV, Wanica, Suriname (clydegriffith@staatsolie.com)

Abstract

During the Equatorial Atlantic Rifting/ Drifting phase, in the northern part South America, one of the key elements was the deposition of organic carbon–rich sediments during the Mid - Late Cretaceous, which was controlled by global and local oceanographic, climatic, and tectonic elements. Now a days, this source rock is referred to as the "Canje" formation, which is the lateral equivalent of the La Luna shale in Venezuela and the Naparima Hill Formation in Trinidad. Oil from this source has been produced from the Tambaredjo, Calcutta and Tambaredjo North West oil-fields onshore Suriname and is also believed to charge the Liza discovery in the offshore area of Guyana. Numerous wells in the offshore area of Suriname have penetrated this prolific source rock. In the Ocean Drilling Program (ODP) wells, CRC-1 well, A2-1 well and NCO-1 well, high Total Organic Carbon (TOC's) and thick Cenomanian-Turonian source rock intervals were also encountered, but they seem to be immature. The maturity of the source is believed to increase towards the NW. High quality source rock also seems to be concentrated within the Albian to the Santonian interval. Biomarkers from the onshore Oil Fields suggest that the oil that is produced, is derived from the Albian Cenomanian – Turonian Source Rock, with other biomarkers which are believed to be derived from a more thicker source rock interval. The question to be asked is: "What is the potential of the Albian Cenomanian – Turonian Source Rock in the Suriname part of the Guiana Basin?

References Cited

Robertson, a CGG Company, 2D and 3D Petroleum Systems Modeling, Suriname – Guiana Basin, Offshore and Onshore South America, Report No. 10328/Ic, 2014, page 13.

Shell International Exploration and Production B.V., 2008. Geochemical investigation of a crude oil sample from well WNZ07, Suriname. Report no. EP 2008-6017.

Shipboard Scientific Party, 2002.

Staatsolie, 2014, Location: http://www.staatsolie.com/pio/

Phenomenon of the Albian Cenomanian Turonian Source Rock in the Suriname part of the Guiana Basin

C. Griffith

1.Introduction

Organic rich Albian Cenomanian Turonian Source Rock was formed during the Equatorial Atlantic Rift Phase. Oil produced from the Tambaredjo, Calcutta and Tambaredjo North- West oil fields onshore Suriname is sourced by the well-known "Canje" Source Rock. There are also offshore wells that have oil shows originating from this source Rock.

High Total Organic Carbons (TOCs) values, ranging between 0.57% and 16%, in the "Canje" Source Rock interval were encountered in the Ocean Drilling Program (ODP) wells, the NCO-1 well, the CRC-1 well, the ATK-1ST2 well and the A2-1 well, all located offshore Suriname (Fig.1). This interval deemed to be immature.

Mature Source Rock is believed to be from Albian to Santonian age and located in the North Western part of the offshore area of Suriname.

In this study, the maturity and charge of the "Canje" Source Rock were modeled for the Suriname part of the Guiana Basin.

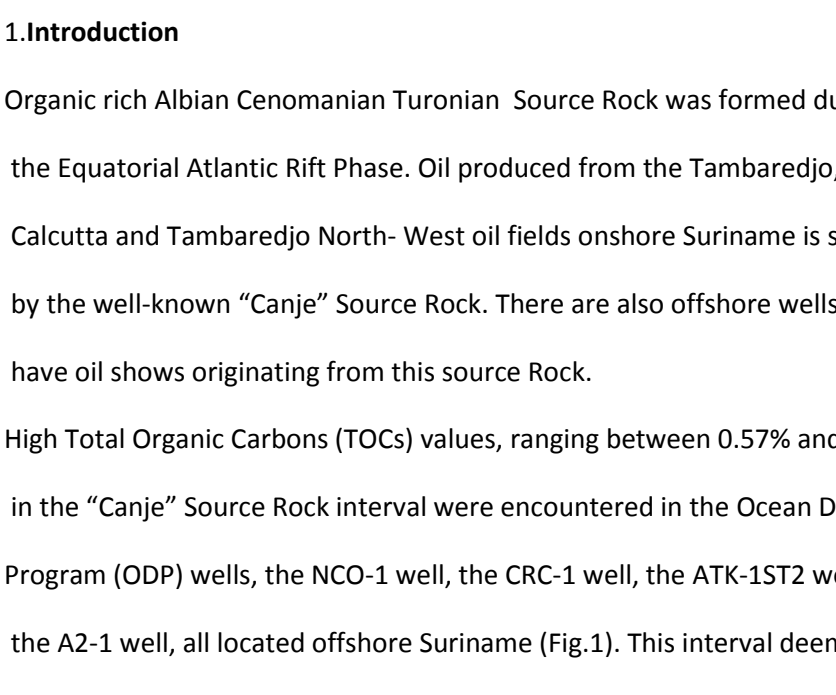

Figure 1: Offshore map with wells that encountered "Canje" Source Rock

2. Background

The Suriname – Guyana Basin is characterized by the presence of a world-class source rock of Albian to Santonian age which is the lateral equivalent of the La Luna shale in Venezuela and Naparima Hill in Trinidad.

Characteristics of the "Canje" Source Rock	
Gross Thickness	Up to 550m
TOC	4-7% in shelf break setting, up to 30% in deepwater setting
Type Source Rock	Marine Type II
Maturity	Maturity model shows the onset of maturity as early as 40 Ma in the east, to 45Ma in the west.
Migration	mainly SSE through Cretaceous and Early Tertiary channels
Migration distance	up to 100-150km

Table 1: Characteristics of the "Canje" Source Rock

The stratigraphy in the Suriname part of the Guiana Basin, with the emphasis on the presence of the various source rocks that were penetrated and possible migration into younger reservoirs is illustrated in figure 2.

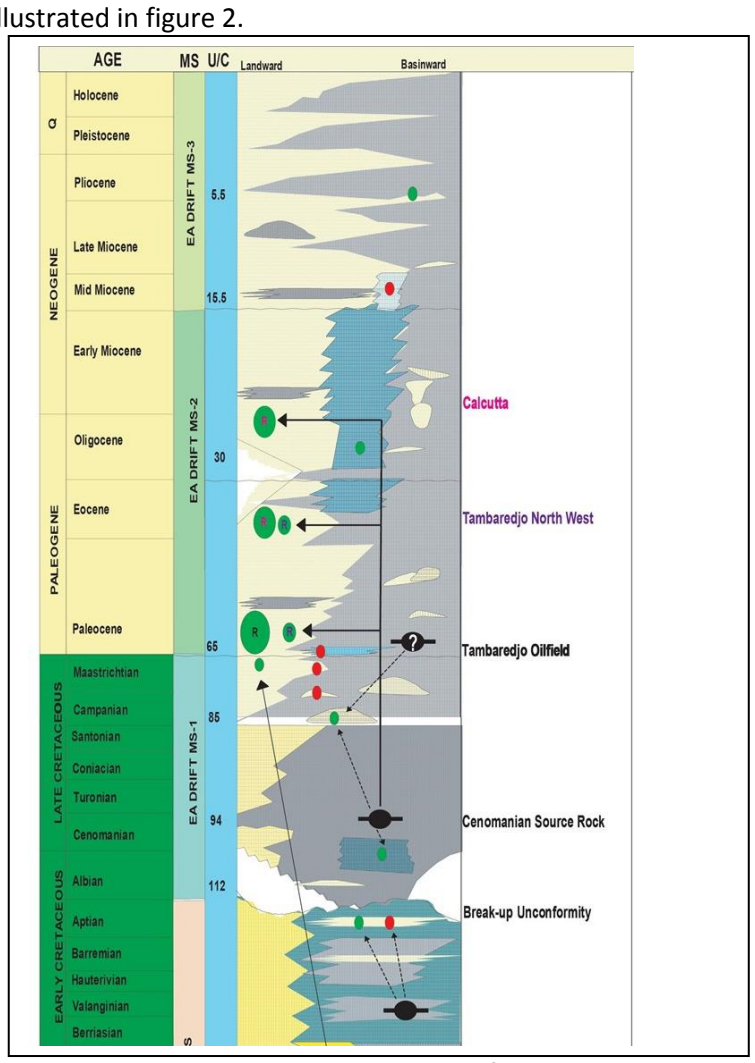

Figure 2: Generalized stratigraphic column for the Suriname-Guyana basin (Staatsolie, 2014).

References

- Staatsolie, 2014., Location: http://www.staatsolie.com/pio/
- Robertson, a CGG Company, 2D and 3D Petroleum Systems Modeling, Suriname – Guiana Basin, Offshore and Onshore South America, Report No. 10328/Ic, 2014, page 13)
- Shell International Exploration and Production B.V., 2008. Geochemical investigation of a crude oil sample from well WNZ07, Suriname. Report no. EP 2008-6017.
- Shipboard Scientific Party, 2002. Leg 207 Preliminary Report. ODP Preliminary Report. Rpt., 107

3. Workflow

The workflow that has been adopted to model the Petroleum System consists of input of well analysis (TOC, HI, VRe,Tmax), paleoenviornment of the Source Rock, horizon mapping and reservoir and seal properties (Fig.3). The geochem data used for the model is illustrated in table 2.

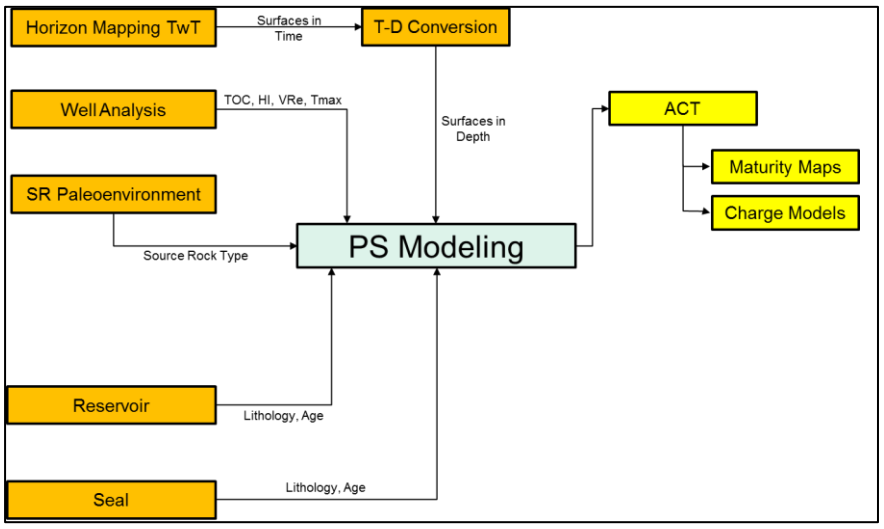

Figure 3: Workflow adopted to model the Petroleum System

The assumptions that were made in the model includes:

- Homogeneous distribution of source rock, reservoir and seal
- Presence of Upper Cretaceous reservoir (N/G = 60%, Sw = 20%) (based on theTambaredjo Oilfield)
- Lithology of Upper Cretaceous reservoir: Sandstone
- Lithology of Paleocene seal: Shale
- Maturity based on Vitrinite Reflectance Classification by Peters, 1994
- Type II/III source rock modeled as Type III source rock in Neritic zone
- Distinction made between Type II and Type II/III based on depositional environment

The limitations of the model includes:

- No faults taken into account for charge model
- Carrier beds in model defined as vertical up to reservoir-seal interval followed by lateral migration up structure
- Software cannot model Type II/III source rock
- Software does not permit ranges for input parameters (TOC, HI)

Well	TOC (%)	VRe (%Ro)	HI	Tmax (°C)	Type	Source
A2-1	0.90 - 6.70	0.00 - 0.47	-			Esso Exploration Suriname INC, 1978
NCO-1	0.92 - 5.18	0.44 - 0.71	123 - 547	435	II	Elf Petroleum Suriname, 1976
CRC-1	0.16 - 2.65	0.00 - 0.75	23 - 282	436 440	II III	Geochemical Solution, 2011
ATK-1ST2	1.64 - 2.97	0.66 - 0.85	0.8 - 643	435 440	II III	University of Houston, 2012
ODP	0.70 - 16.00					ODP, 2003

Table 2: Geochem data used for the model.

4. Results

A regional Paleoenvironment model was created for the Albian Cenomanian Turonian Source Rock with the available Paleo data in the wells. With this model maturity maps were created for the Albian Cenomanian Turonian Source Rock, which seems to match the maturities that were observed in the wells (Fig.4).
The migration modelling resulted in various migration pathways and accumulations across the offshore area of Suriname (Fig.5)

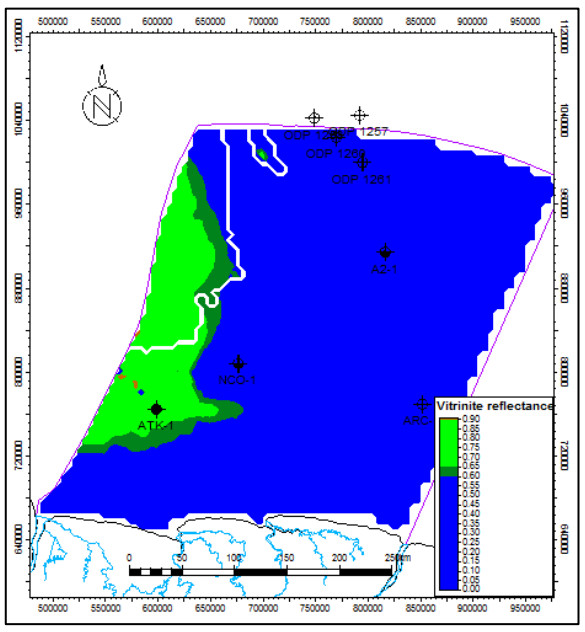

Figure 4: Albian Cenomanian Turonian Source Rock maturity map

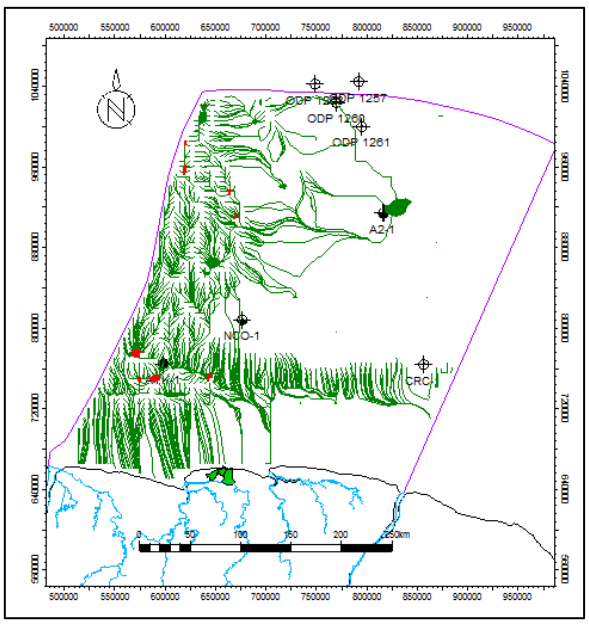

Figure 5: Albian Cenomanian Turonian Source Rock migration pathways map

5. Conclusions

Maturity and charge models of the "Canje" Source Rock were modeled for the Suriname part of the Guiana Basin. The following conclusions can be drawn from the study:

- The Albian Cenomanian Turonian Source Rock maps show presence of oil and gas generation in the basin.
- Based on these migration models various Upper Cretaceous prospects have been charged

6. Recommendations

The following recommendations can be noted:

- For a more accuracy, create a 3D migration model, honoring all data points.
- Include faults in migration model.