The East Georges Bank Basin, Offshore Nova Scotia: An Undrilled Basin with Significant Oil and Gas Potential*

Tako Koning1

Search and Discovery Article #10299 (2011)
Posted February 15, 2011

*Adapted from poster presentation at AAPG Annual Convention and Exhibition, New Orleans, Louisiana, April 11-14, 2010

1Public Relations, Tullow Oil, Luanda, Angola (tako.koning@tullowoil.com)

Abstract

The East Georges Bank Basin is located offshore Nova Scotia on the southeastern Canadian continental shelf. The basin covers 10,000 square kilometers (2.5 million acres) and is one of the last undrilled basins in North America.

The geological understanding of this basin is based on 16,000 km of seismic data which was studied and interpreted in the 1980’s by Texaco Canada’s geoscientists. The first public presentation of the interpreted data was at a conference of the Canadian Society of Petroleum Geologists in 1988 in St. John’s, Newfoundland and thereafter the geological and geophysical interpretations were presented at a number of oil industry conferences worldwide (San Diego, Calgary, Lagos, Rio de Janeiro). This presentation is a re-presentation of the 1988 and subsequent papers. In 1988, the government placed an oil activity moratorium on Georges Bank. No activity such as seismic surveying has taken place since that time. Therefore, although this presentation is based on old seismic data, it must be viewed as up-to-date since no new data has been acquired on the bank for over twenty years.

The overall Georges Bank Basin formed during the Triassic when the landmass of Pangea began separating along rift zones. A prominent Paleozoic basement high, the Yarmouth Arch, separated the East Georges Bank Basin from the West Georges Bank Basin, and had a dominant influence on sedimentation until Middle Jurassic. During the Middle Jurassic, major growth faulting and halokinesis commenced in the basin.

The structural and stratigraphic evolution of the East Georges Bank Basin has resulted in the development of a number of significant and economically attractive seismically-defined prospects. The Geological Survey of Canada (GSC) published in 1983 (Proctor et al) that the average hydrocarbon expectation of the basin was $168 \times 10^6$ m$^3$ barrels oil (1.0 billion barrels) and $150 \times 10^9$...
m$^3$ natural gas (5.3 TCFG). The GSC’s speculative estimate for the basin was $350 \times 10^6$ m$^3$ barrels of oil (2.1 billion barrels) and $307 \times 10^9$ m$^3$ gas (10.8 TCFG). The East Georges Bank Basin remains under the moratorium until 2012 at which time the moratorium may either be lifted or continued.
The East Georges Bank Basin, Offshore Nova Scotia – an Undrilled Basin with Significant Oil & Gas Potential

Tako Koning
Advisor – Tullow Oil
Luanda, Angola, West Africa
Poster Presentation at the 2010 Annual Convention of the American Association of Petroleum Geologists, New Orleans, Louisiana
Previous presentations about the East Georges Bank Basin

• 1988 CSPG-GAC-MAC Symposium on “Extensional Tectonics & Stratigraphy of the North Atlantic Margins”, St. John’s, Newfoundland, authors Allan Carswell and Doug Hibbs, Texaco Canada Resources Limited
• 1990 Koning, T, Carswell, A, AAPG Convention, San Francisco
• 1991 Koning, T, Carswell, A, CSPG Convention, Calgary
• 1992 Koning, T, Carswell, A, CSEG Convention, Calgary
• 1992 Koning, T, NAPE Convention, Lagos, Nigeria
• 1993 Koning, T, CSPG Convention, Calgary
• 1998 Koning, T, CSPG International Division, Calgary
• 1998 Koning, T, AAPG International Confer., Rio de Janeiro, Brazil
• 2008 Koning, T, Conjugate Margins Conference, August 2008 Dalhousie University, Halifax, Nova Scotia
• 2009, Koning, T, CSPG International Division, Calgary
• 2010, Koning, T, AAPG Convention, New Orleans
Specific Information on Previous Presentation on East Georges Bank Basin

East Georges Bank Basin

- East Georges Bank Basin covers 10,000 sq km (2,200,000 acres)
- One of the last undrilled basins in North America
- This interpretation is based on 16,000 km of vintage seismic data shot by Texaco in the early 1980’s (Jebco data)
- East Georges Bank Basin (Canadian side) is geologically very different from West Georges Bank Basin (USA side)
- Basin has significant hydrocarbon potential, likely for natural gas (not oil) albeit with high exploration risk
- In 1986, Texaco Canada was preparing to drill 2 exploration wells but a provincial and federal government imposed moratorium halted the program
- Oil & gas moratorium in place since 1986 (24 years)
- In May, 2010, the moratorium was extended from 2012 to 2015 due to the Nova Scotia government’s concerns about BP’s Gulf of Mexico oil well blow-out
FIGURE 2

LAHAVE PLATFORM

P-23

14Km

TRANSCURRENT FAULTS

WEST GEORGES BANK BASIN

YARMOUTH ARCH

YARMOUTH SUBPLATFORM

PALEOSENSELF EDGE

EAST GEORGES BANK BASIN

200m

2000m

0 24 Km

0 16 Mi.
FIGURE 17

SCHEMATIC, REGIONAL CROSS-SECTION
GEORGES BANK

WEST GEORGES BANK BASIN

YARMOUTH ARCH

YARMOUTH SUBPLATFORM

TERTIARY CLASTICS
CRETACEOUS CLASTICS
JURASSIC CLASTICS

EAST GEORGES BANK BASIN
Georges Bank Basin (USA side) Exploration History

- 1976 & 1977: Drilled 2 COST wells (Continental Offshore Stratigraphic Tests)
- 1979: Lease sale, total bonuses $816 MM
- 1981 & 1982: 8 exploration wells drilled by Exxon, Conoco, Tenneco, Mobil, Shell
- Well water depths 210’ – 455’, drill depths from 14,100’ – 21,900’
RESULTS OF DRILLING IN GEORGES BANK (USA SIDE)

• West Georges Bank Basin is a minimally deformed basin (“layer cake”)
• Exploration wells were drilled on stratigraphic prospects all with high amplitude reflectors
• Only 4 wells penetrated Jurassic and older
• Low porosity carbonates intersected – no hydrocarbons
• No significant hydrocarbon source rocks encountered; sediments were “organically lean” (except Tenneco-1 with 1.65 TOC in Triassic)
FIGURE 13

- CANADA
- U.S.A.
- DELTA COMPLEX
- PALEOSHELF EDGE
- SHELF CARBONATES
- ABENAKI EDGE
- SALT MOVEMENT OCCURRING
- CLASTIC DRAPE
- GROWTH FAULTING DUE TO INCREASED CLASTIC INPUT

MIDDLE & LATE JURASSIC

Legend:
- 200m
- 2000m
- 24 Km
- 16 Mi.
SLOW DEPOSITION OF FINE CLASTIC ON A STABLE CONTINENTAL MARGIN.

CRETACEOUS TO PRESENT
SCHEMATIC, REGIONAL CROSS-SECTION
GEORGES BANK

- TERTIARY CLASTICS
- CRETACEOUS CLASTICS
- JURASSIC CLASTICS
- YARMOUTH ARCH
- YARMOUTH SUBPLATFORM
- WEST GEORGES BANK BASIN
- EAST GEORGES BANK BASIN
Summary: Geological Differences Between USA Side of Georges Bank and the Canadian Side

- The Jurassic section is very thick on the USA side (west of the Yarmouth Arch) with up to 12,000 feet of sediments in comparison to up to 2,000 to 4,000 feet of section on the Canadian side (east of the Yarmouth Arch)

- Jurassic velocities are very fast on the USA side with average velocities of 16,000 – 18,000 feet per second (indicating carbonates & confirmed by well control) whereas velocities on the Canadian side are slower at 14,000 – 16,000 feet per second indicating likelihood of sandstones

- The USA side is structurally “layer cake” whereas the Canadian side is highly structured with many seismically defined growth faults, well defined salt structures and indications of possible Jurassic age reefs

- This infers that the East Georges Bank Basin is geologically very different from the West Georges Bank Basin and that the dry holes drilled on the USA side do not downgrade the oil & gas potential on the Canadian side
Looking for analogues in Morocco

- AAPG field trip in 1992 (led by Dr. John Warme)
- You can observe in outcrop everything that has been interpreted on seismic in the subsurface of the East Georges Bank Basin including alluvial fan deposits (red beds), turbidites and reefs
THE HIGH ATLAS MOUNTAINS, CENTRAL MOROCCO
TRIASSIC-EARLY LIASSIC REDBEDS (DRY RIFT PHASE)
MIDDLE JURASSIC - RIFT FILLS, SHALLOW MARINE TO CONTINENTAL
SURFACE GEOLOGY MAP, RICH AREA, HIGH ATLAS MOUNTAINS, MOROCCO
SHOWING GENERALIZED DOGGER (L. JURASSIC) REEF FACIES AND LITHOFACIES
(AFTER BURKE AND WARMEN, 1992)
MIDDLE JURASSIC (DOGGER) PINNACLE REEFS (4 EXPOSED) ALONG FAULT SCARP
MIDDLE JURASSIC PINNACLE REEF CONSISTING OF CORALGAL REEF BUILDERS (UP TO 90 M THICK)
CONCLUSIONS

• East Georges Bank Basin covers 10,000 sq km (2.5 million acres) and is one of the last undrilled basins in North America
• Geological interpretations are based on 16,000 km of 1980’s and earlier seismic data
• The East Georges Bank Basin is geologically different from the West Georges Bank Basin
• Geological Survey of Canada in 1983 published average hydrocarbon expectation of the basin was 1.0 billion barrels oil and 5.3 TCF gas; speculative estimate was 2.1 billion barrels oil and 10.8 TCF gas
• In comparison, Sable Offshore Energy Project has produced 1.5 TCF gas, full life will be 2.0 TCF gas and Deep Panuke will be about 0.7 TCF gas, thus in comparison, East Georges Bank Basin represents the potential for highly important reserves of gas for the province of Nova Scotia