

#### The Governor's Conference on Energy

#### Track – Reducing Our Dependence on Foreign Oil Session – The Technology of Exploration and Development

**US Atlantic Margin Geotechnical Evaluation Dwight "Clint" Moore Vice-President of Corporate Development** October 17th, 2011

# Outline

- ION's relevance to today's discussion
- What is the exploration history of the basin?
- Key Geologic Questions
- Current data available wells and seismic
- Historical Overview of Exploration Activity
- Tectonic Elements
- Sub-basin overview
  - Georges Bank
  - Baltimore Canyon Trough
  - Carolina Trough
  - Blake Plateau Basin
- Challenges and Government Delays
- Conclusions & Recommendations

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#### ION's relevance to todays discussion.

- In early 2007 ION identified a major data gap in basic geologic understanding of the US Atlantic Margin.
- In an attempt to answer this major data gap, in 2008 ION filed an exploration geophysical permit application with the then MMS.
  - In support of this application ION filed a survey specific, NEPA level EA ,and an IHA application with the NOAA National Marine Fisheries Service on October 2nd, 2008
- Governmental response to ION's application was mixed
  - NOAA NMFS was prepared to process our EA / IHA
  - MMS fearing the precedent that this application would set and the resulting work load generated if seismic contractors could file survey specific EA / IHA at will; responded by denying our application and filing a Notice of Intent to Prepare a PEIS, on Jan. 21, 2009

#### **US East Coast Existing Seismic Database**



#### **Key Geologic Questions**

- Our plan is to address the following major data gaps left by the existing data library.
  - Depth to basement
    - Understand heat flow along margin
  - Image below Jurassic carbonate shelf margin
    - Potential petroleum system?
    - Understand distribution of salt
  - Sediment thickness variations between basins along the margin
  - Overall modernization of Petroleum Systems interpretation and Basin Analysis Modeling, applying today's global models, processes, concepts, and ideas.

## **Atlantic OCS Tectonic Elements**



Source: AGS



## **Atlantic OCS Tectonic Elements**



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## East Coast N.A. Discoveries

	2000 Assessment Mesozoic Stratigraphy								
Gulf of Mexico Basin		Gulf of Mexico Basin	South Florida Basin	Gulf of Mexico Plays*	Atlantic Basin/ Scotian Basın	Atlantic Plays		•	No
Cretaceous	Upper	Selma Gp Taylor Gp Eutaw Fm Eagle Ford Gp Tuscaloosa Gp	Pine Key Fm	UK2 CI	Wyandot Fm Dawson Canyon Fm Mid DG Mbr Sable Island Mbr	PA NI IT			Cre Mic
	Lawer	Dantzler Fm Washita Gp Fredericksburg Gp Paluxy Fm Glen Rose Fm Mooringsport Fm Ferry Lake Fm Rodessa Fm James Fm Pine Island Fm Sligo (Pettet) Fm Hosston Fm Cotton Valley Gp	Dollar Bay Fm Sunniland Fm Brown Dolomite Zone Pumpkin Bay Fm Bone Island Fm	LK8LK3 B1 LK8 B1 LK8LK3 B2 LK8 B1 LK8LK3 B3 LK3 B1 LK8LK3 B1 LK8 B1	Logan Canyon Fm Upper Missisauga Fm — 0 Marker — M. Simplex shale Lower Missisauga Fm Mic Mac Fm			•	Ne Cre Hib
Jurassic	Upper	Cotton Valley Gp Haynesville Fm Buckner Fm Smackover Fm Norphiet Fm	Wood River Fm Basal Clastics	UU4 A1 UU4 B1 UU4 X1 UU4 B2 UU4 X2 UU4 C1 UU4 2C1	Mohawk Fm Motran Mbr	AUJ D1	AUJ B1	•	Ne
	Middle	Louann Salt	Non-Deposition		Abenaki Fm Mohican Fm	AMJ CI	AMJ BI		Jur Oil
	Lower		Easement		Argo Salt				
Triassic	Upper	Eagle Mills Fm	Description		Eurdice Fm			Sou	rce:
		Dasement			Dasement				.000 A.

- Nova Scotia Offshore Discoveries Cretaceous Missisauga & Jurassic Mic Mac Gas – Giant Venture Gas field plus 6+ others
- Newfoundland Offshore Discoveries -Cretaceous Jeanne D'Arc - Giant Hibernia Oil field plus 4+ others
- New Jersey Offshore Discoveries Jurassic Gas with some Cretaceous Oil – Giant HC 642 Gas field

## East Coast Activity Summary



- 46 industry wells drilled, 1978 1984
- 5 COST wells drilled, 1976 -1979
- 1 discovery HC 598, 599, 642
- Only 4 wells drilled in >1500m WD
- Manteo Multi-TCF Jurassic shelf margin play with gas clouds and amplitude events
- No activity since 1984
- MMS YTF Estimates
  - 3.8 Bbbls, 37 Tcf, (10.1 BBOE)

#### **East Coast Exploration History**



## **Baltimore Canyon Discovery**



## **Baltimore Canyon - Summary**





- •Federal Sale 40 1976 (CPA)
  - •93 leases awarded
  - •\$1127MM in bonus bids (\$42.4 billion)
- •Federal Sale 49 1979
  - 39 leases awarded
  - •\$40MM total bonus bids (\$118 MM)
- •Federal Sale 59 -1981
  - •51 tracts awarded
  - •\$324 MM total bonus (\$766 MM)
- 2 COST Wells B-2 and B-3
- 28 Exploration wells drilled 1978-1981
- 4 Exploration Wells drilled 1981-1982
- 5 Discoveries Estimated 750 Bcf 50MMBO

### Baltimore Canyon Trough Exploration Plays



- Jurassic reef has dramatic seward trajectory (>40 km progradation.
- This basin has the thickest post-rift sediment isopach (>14km)
- Syn-rift section not imaged

Majority of exploration wells drilled in Baltimore Canyon
Primary objective was Jurass

- Primary objective was Jurassic shelf margin carbonate and clastics.
- Deep-water wells drilled by Shell in 1984 also tested Cretaceous reef facies.



## Baltimore Canyon Trough – Line 25

106-1 B-3



- Better image of deep trough
  - Transitional continental to oceanic crust
- How much salt is present in this basin?
- What underpins the Jurassic carbonate shelf margin?
- Shelf margin extension thick or thin skinned?
- Potential for sub-salt play in this basin
  - Thickness of syn-rift strata

# Carolina Trough

Exploration Activity Summary



No exploration wells in this sub basin.

#### Carolina Trough Depth to Basement



Carolina Trough Basin geometry different from other EC Basins Syn-rift poorly imaged, possibly contains SDR's. Mesozoic strata are untested in this sub-basin

## ECST Line 32



#### **Blake Plateau Basin - Summary**



- 6 Exploration wells drilled between 1977-1982
- COST GE-1 well
- All wells D&A did not test thick Mesozoic section
- Significant gas hydrate accumulation has been evaluated by ODP wells (600 Tcf)
- ODP and DSDP data provide stratigraphic control points for the basin



#### **Blake Plateau Basin**



## **DSDP Site 627**



#### **Blake Plateau Summary**

- Difficult to image basement
- Variation in basement terranes likely
- Presence of syn-rift section below shelf carbonate strata?
- Indication of salt no definitive profiles
- Logical tie and correlation with the Eastern GoM and Florida escarpment



### **Geologic Summary**

- While the volume of work on the US Atlantic margin is significant, it is very outdated.
- New data such as ION's USAM program should focus on helping to define basement terranes, geometries and syn-rift deposits.
- The regional strike (N-S) lines over the Jurassic shelf margin will be critical to understanding the basin evolution, salt distribution and basement geometries.
- All key stratigraphic information from ODP and DSDP wells will be essential to dating sequences.

#### **Challenges and Endless Government Delays**

- Fed. Moratorium lifted in July 2008 inaction followed
- PEIS Delays PEIS announced Jan. '09 31 months ago
- Will next 5 year plan even have a East Coast Lease Sale?
- Probable Incidental Harassment Authorization delays
- Probable seismic permitting delays
- Laborious, time consuming filings and process times
- Probable lawsuits and injunctions
- Uncertainty of future Costal Marine Spatial Planning?
- Most recent 3+ years lost 5+ years to go?

#### Value of Virginia OCS Exploration

According to the ICF study, new OCS exploration and production would provide the following economic impacts in Virginia:

- Create approximately 1,888 new direct jobs in Virginia; +1,000's?
- Add over \$365 million annually to GDP by 2030; and
- Generate ~ \$19.48 billion in federal, state and local revenues, including \$1.275 billion in government revenues by 2030

#### Table 2 - Virginia Resource Value

	Value of Oll	Value of Natural Gas	Total Value of Resources	
95 <sup>th</sup> Percentile	\$7.5 billion	\$10.0 billion	\$17.5 billion	
Mean	\$25.5 billion	\$25.9 billion	\$51.4 billion	
5 <sup>th</sup> Percentile	\$50.5 billion	\$46.5 billion	\$97.0 billion	

#### Table 3 – Federal Revenues from Potential Virginia Resources

	Royalty Revenues	Bonus Bids	Total Federal Revenues
95 <sup>th</sup> Percentile	\$3.3 billion	\$0.3 billion	\$3.6 billion
Mean	\$96 billion	\$1.0 billion	\$10.6 billion
5 <sup>th</sup> Percentile	\$18.2 billion	\$1.8 billion	\$20.0 billion

#### Table 4 - Potential Virginia Revenue Share

	Royalty Revenues	Bonus Bids	Total VA Revenues
95 <sup>th</sup> Percentile	\$1.2 billion	\$0.1 billion	\$1.3 billion
Mean	\$3.6 billion	\$0.4 billion	\$4.0 billion
5 <sup>th</sup> Percentile	\$6.8 billion	\$0.7 billion	\$7.5 billion