Presentation Overview

- General geologic setting
- History of Oil and Gas Exploration
- Petroleum Geology of North Carolina State Waters areas
- USGS Oil & Gas Resource Assessment Process
- Current USGS Oil & Gas Resource Assessment Activities: East Coast Mesozoic Basins Study
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General Geologic Map of North Carolina

(from Reid and Milici, 2008)
U. S. Atlantic Mesozoic Basin Types

USGS Assessment

Onshore Basins

“Exposed” Rift Basin

“Buried” Rift Basin

Offshore Basins

MMS Assessment

U-M Jurassic Shelf Margin

Post - Rift Sag Basin

Onshore Basins

Offshore Basins

Composite North American Igneous + Metamorphic Terranes

Break-up Unconformity

Cretaceous

Jurassic

Moho

seaward dipping seismic reflectors

Atlantic Ocean

Tertiary

Oceanic Crust

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USGS
Exposed Rift Basins

Buried / Inferred Rift Basins

(simplified from Benson, 1992; Horton and others, 1991; Zietz and others, 1984)
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North Carolina Oil & Gas Drilling History (1925 – 2009)

- 129 wells drilled since 1925 (1925-1998)
- 116 dry holes; plugged and abandoned, with no shows
- 11 wells had oil and/or gas shows; all abandoned
- 1 well had oil and gas shows; shut-in
- 1 well plugged following mechanical failure
North Carolina Triassic Basin Tests

- Chevron #1 Groce (1974): 5348’ TD basement test; several oil & gas shows; thick gasey coals and organic shales; low P&P sandstones
- SEPCO (Seaboard) #1 Hall (1983): 4622’ TD; oil shows
- SEPCO (Seaboard) #1 Butler (1984): 4538’ TD basement; substantial oil & gas shows; acidized & frac’d; flowed low rates of gas + condensate before being abandoned
- Amvest #3 Butler (2006): 2655’ TD; shut-in gas well
- Amvest #1 Simpson (2006): 3294’ TD; shut-in gas well
- Several wells in eastern NC have reported oil and/or gas shows from unspecified units
Butler #1 (above) – high paraffin oil, low flow temperature (~ext. body temp.); in geochem. testing at USGS

Butler #3 (right) – shut-in well head pressure; sampled for gas geochemistry; has liquids along with gas; in geochem. testing at USGS

(modified from Reid and Taylor, 2009)
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Early Deep Tests – North Carolina Coastal Plain & State Waters

Esso Hatteras Light No. 1
10,054 ft TD Xline Bsmt
D&A 1946
no shows of oil or gas

North Carolina Esso No. 2
6,410 ft TD L. Cret.
D&A 1947
no shows of oil or gas

(from Spangler, 1950)
Eastern North Carolina Drilling History

- **1946 & 1947**: 2 Deep Esso tests vic. Cape Hatteras
  - Drilled following major geophysical surveys (seismic, gravity, magnetics)
  - Both dry and abandoned
  - 1 cored crystalline basement at TD
  - No oil or natural gas shows

- **1953**: 1 well drilled in Camden Co, NC into Triassic; 6421 ft TD; show of gas in Cretaceous Tuscaloosa Fm.; plugged & abandoned

- **1965**: 7 basement tests drilled in & adj. to Albemarle & Pamlico Sounds
  - All dry and abandoned
  - 6 of 7 cored crystalline basement at TD
  - No oil or gas shows

- Approx. 86 wells drilled in vic. Albemarle & Pamlico Sounds; most drilled to basement; all dry and abandoned
Geologic Section from the Fall Line to the Atlantic Ocean, North Carolina

(modified from Maher, 1971)
Eastern North Carolina Petroleum Show Reports

9 wells reported shows:

• Camden Co.: show of gas while drilling(?) in L. Cret. (?).
• Carteret Co.: show of gas in unk. fm.
• Dare Co.: show of gas in L. Cret.(?): prod. test, no details
• Hyde Co. Offshore: show of oil in U. Cret.(?): oil fluorescence in sidewall core
• Pamlico Co.: (1) show of oil & gas: many DST’s - O&GCM from 1 (L. Tert.-?); many cores – gas from 1 (U. Cret.-?); (sidetrack/redrill?) Core & DST recovered oil (U. Cret.-?)
• Pender Co.: show of oil & gas: no details
• Tyrrell Co.: show of oil & gas, poss. in basement rock: prod. test, no details
• Unspecified locations: 2 wells drilled in 1966 reported mud logger gas shows

(adapted from data from IHS Inc., 2009, and Richards, 1947, 1954)
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USGS Oil and Gas Resource Assessment Process

- Geologically based
- Identification of Total Petroleum System(s) (TPS):
  - √ Source Rock
  - √ Reservoir Rock
  - √ Sealing Intervals
- Identification of Assessment Unit(s) (AU’s):
  - √ Geologically-bounded areas with known or hypothetical production capabilities
  - √ Plays and known (or shut-in) fields
USGS Oil and Gas Resource Assessment Categories

• Conventional Accumulations:
  – Definable, field-wide hydrocarbon:water contact

• Continuous (“Unconventional”) Accumulations:
  – Ill-defined, field-wide hydrocarbon:water contact
  – i.e., coal bed methane, shale gas, tight gas sandstones

• Hypothetical:
  – Either conventional or continuous; however,
  – No historically or currently established production
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- **Current USGS Oil & Gas Resource Assessment Activities: East Coast Mesozoic Basins Study**
1995 USGS Oil and Gas Resource Assessment

- All plays deemed “hypothetical”
- Reservoirs: a variety, incl. conglomerates, sandstones, shales, and coals; ss = 2 – 12% Φ & <0.1 md – 18 md k
- Source rocks: lacustrine black shales and coals; thermally immature to (prob.) past-peak gas; generation prob. Late Triassic – Early Jurassic, poss. cont. into Cretaceous
- Traps: both extensional & compressional (transpression) structures
- Discoveries/shows: no production reported in 1995 assessment; many oil and gas shows reported
- Resource potential: “fair to poor”; no volumes assessed

(from Milici, 1995)
2009-10 USGS Oil and Gas Resource Assessment - Preliminary Status (as it pertains to Eastern North Carolina Onshore and State Waters Areas)

- Only 2 positively identified rift basins in eastern part of state, although some geophysical evidence suggests others may be present
- No geochemically identified source rocks (yet?)
- Hydrocarbon shows not confirmable (yet?)
- Highly porous potential reservoir rocks
- No data on capabilities of potential seal intervals
- No identified structures